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Vol. 231 No. 4719 16 – 29 June 2023

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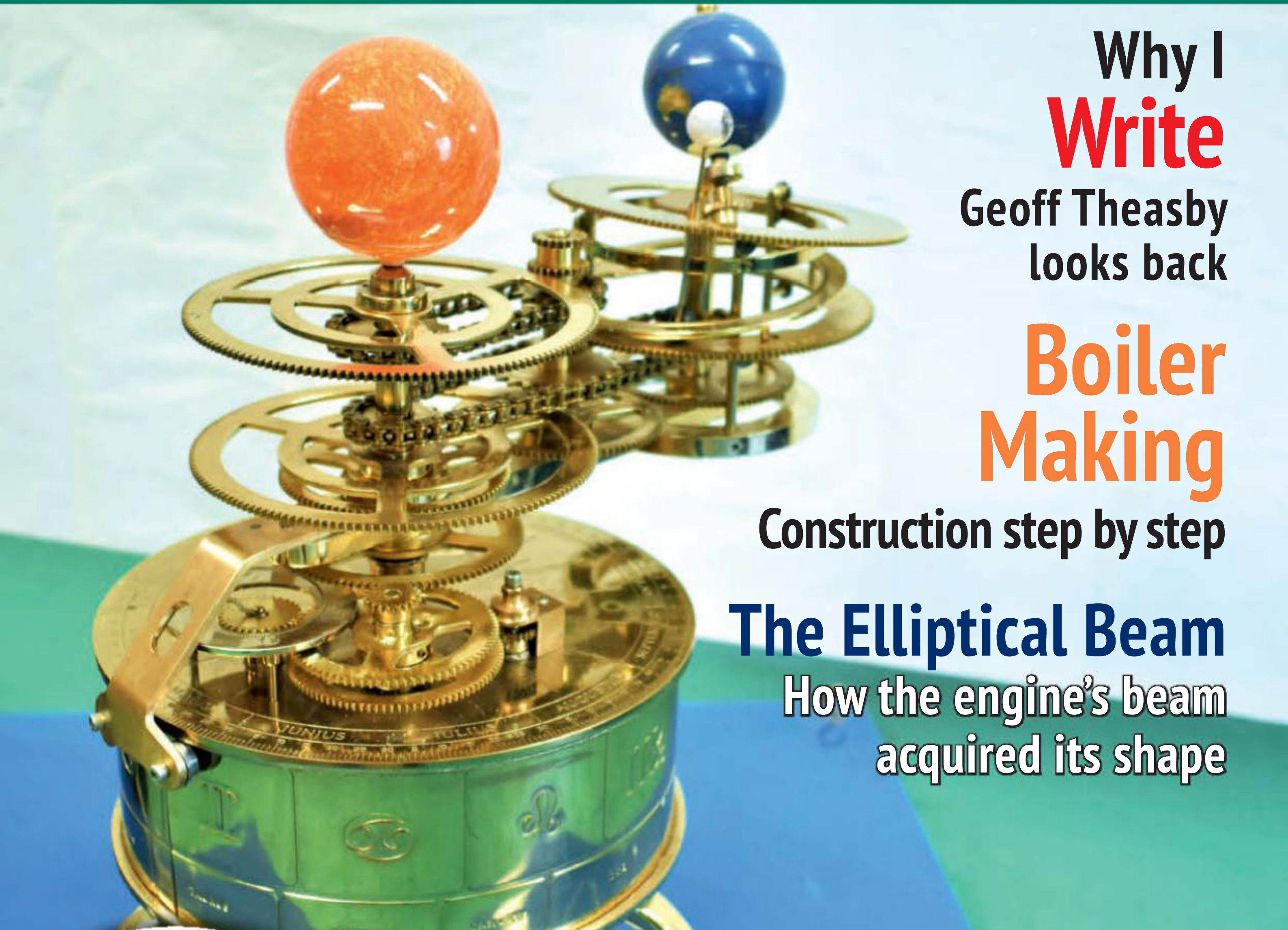

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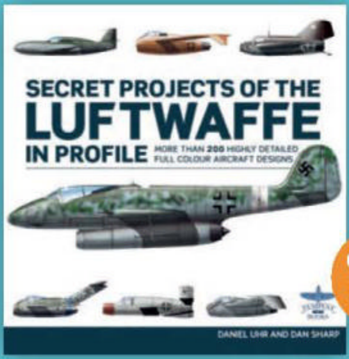
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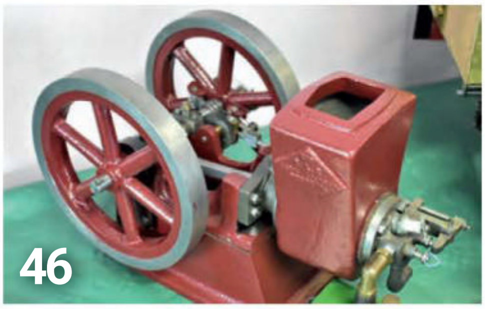

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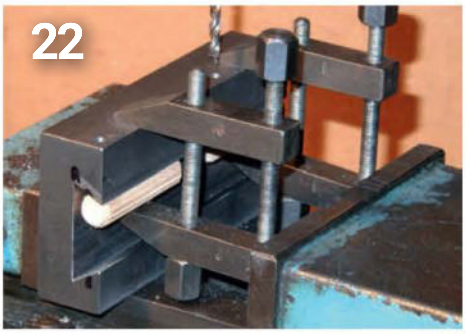

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ON THE COVER...

A solar system model simulating the motion of the earth and moon around the sun by Ron Baier of the Pickering society (photo: John Arrowsmith).

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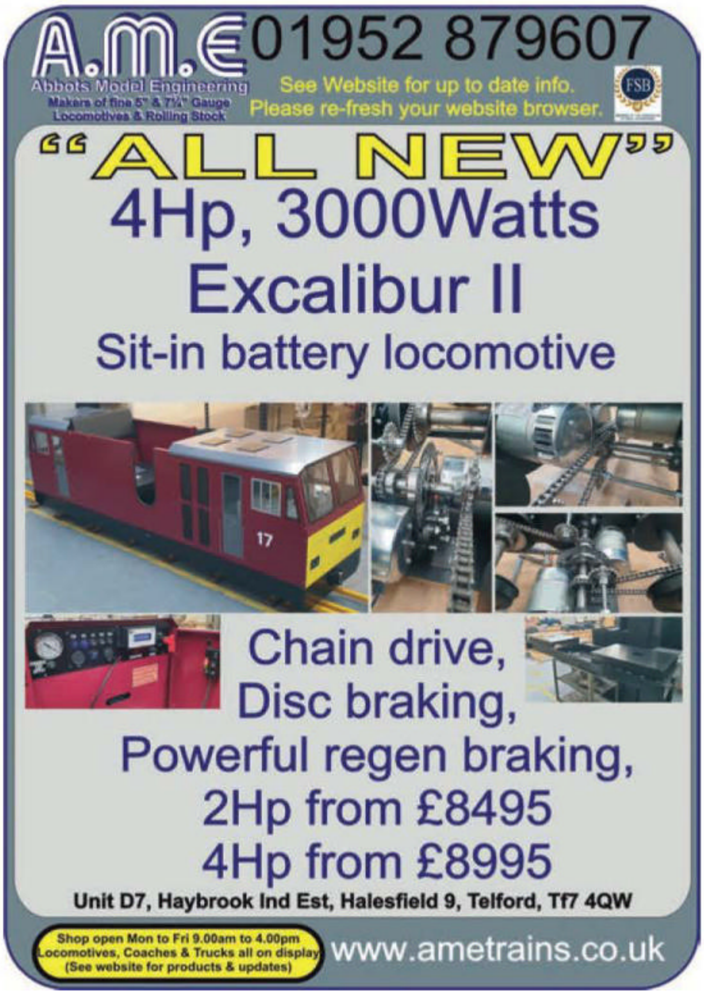
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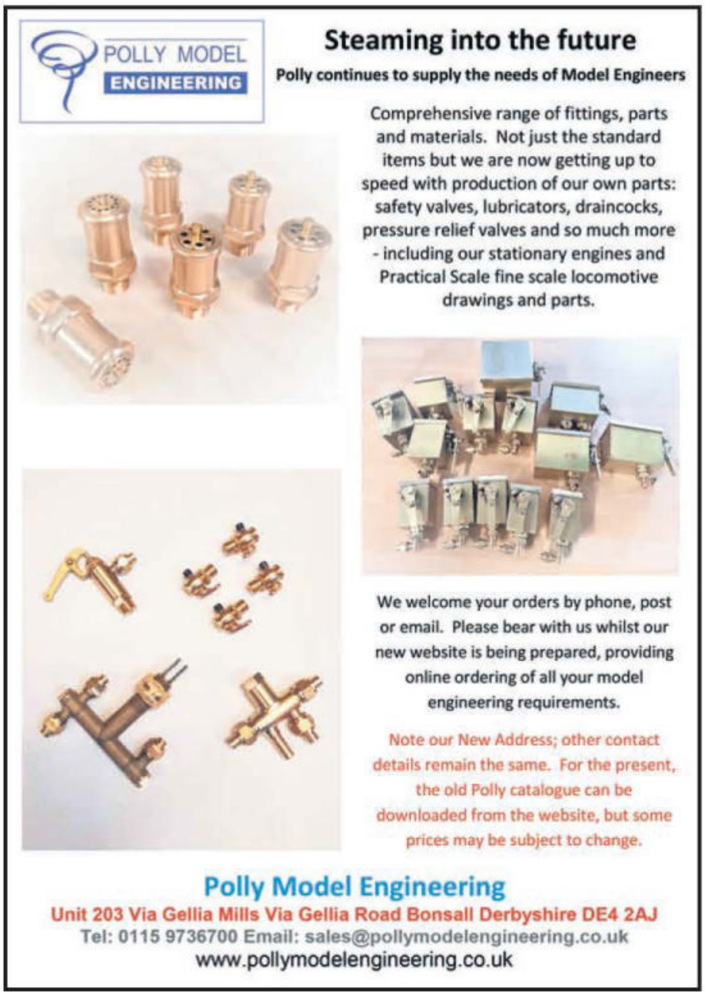
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SMOKE RINGS

MARTIN EVANS
Editor

DIANE CARNEY
Assistant Editor

Parklands Railway

On Sunday May 28th I had the pleasure of attending the first full running day of this year's Parklands Railway Week, up at Hemsby on the Norfolk coast near Great Yarmouth. The Parklands railway is a 7¼ inch gauge railway in the grounds of a holiday park created by the late Don Witheridge and the railway week has now been an annual event (except during covid, sadly) for over 40 years. There was a total of 23 engines present when I visited and most were staying for the entire week. I include here a couple of pictures of visiting locomotives to be going on with and we hope to include a more comprehensive report in a forthcoming issue.

Summer Events

There are two events coming up in July which should be in the diary of anyone within reach of either Guildford or Oxford. In Guildford, on Saturday and Sunday the 1st and 2nd from 10am to 5pm at Stoke Park there is the Railway Gala, organised by the Guildford MES. There is a ground level railway and a raised track, both offering rides, model traction engines, two model boating pools and a display of steam models. Hot food is also available. What's more admission is free (except for the train rides – at modest fares) and so is parking. More details are at www.gmes.org.uk/events.htm

Stoke Park Gala

Stuart Duncan waits to leave the station sitting behind GWR 6868 Penrhos Grange*. The locomotive was built originally from works drawings by Tony Newbury and beautifully rebuilt by Stuart's son James.*

Martin Parham blows down a very elegant Stirling Single, built from works drawings and exact in every detail, while Sue Parham observes from a respectful distance.

At Cutteslowe Park, Oxford from the 21st to the 23rd there is the 'Dreaming Spires' rally. Home to the second-best university in the country (ahem!), Oxford is also home to the club organising this event. Road vehicles are welcome and railway locomotives of 3½, 5 or 7¼ inch gauges are invited to run on the ground level or raised tracks, provided of course they are equipped with a valid boiler certificate (if relevant). More information, if you plan to attend, is available from the club chairman, Denis Mulford (denis.mulford@btinternet.com).

Geoff Theasby

Many of you may have wondered why Geoff Theasby writes for this magazine (I know I have) but it is now no longer a mystery. On page 38 Geoff spills the beans and reveals his motivations for putting pen to paper (apart from the accumulation of riches, of course). As befits a model engineering magazine, it's riveting stuff.

Martin Evans can be contacted on the mobile number or email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.
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The Eating of Elephants

PART 16 – STEPS BIG AND SMALL

Steve Goodbody finds some things are best tackled in small helpings

Continued from p.736
M.E.4718 June 2

Having started to build *Elidir*, a 7¼ inch narrow-gauge quarry Hunslet locomotive, and with A-level studies also underway, the author has discovered that the long daily journey to Brighton, coupled with more homework than he has ever seen in his life, are not conducive to steam engine construction. Taking this into account, he has revised *Elidir*'s timing estimate upwards to eight years, certain in his belief that it could not possibly take longer.

Perceptive readers might disagree with his conclusion.

Progress, or lack thereof

'*Never judge a man until you've walked a mile in his moccasins*'. Sound advice, if ever I heard it, and, in just twelve words (thirteen, if you count '*you've*' as two words, which you shouldn't) it neatly captures the idea that we all have constraints, and we all have limitations, and we are none of us the same as each other, and therefore we must all be wary of jumping to conclusions and casting aspersions because, chances are, we don't know all of the relevant facts.

And, having deployed that defensive smokescreen, I can now admit that, having more limitations and constraints and differences than most, and thanks in large part to those annoyingly insistent educational demands which now ruled my life, and while I did manage to get *Elidir* up onto her wheels over the course of that nine-month period (**photo 92** and **photo 93**), no further advancement was made during the school year. In short, by July of 1986, progress had been, not to put too fine a point on it, unimpressive.

However, like the proverbial bad penny, the school summer holiday eventually rolled around once again and this time I was ready. For now, in the workshop, in an almost-too-heavy-to-lift cardboard box, and having once again consumed nearly all of my saved pocket money, sat the entire set of cylinder castings for a certain narrow-gauge Hunslet locomotive. And, come hell or high water, I intended to get those castings machined and installed before the summer holidays were over.

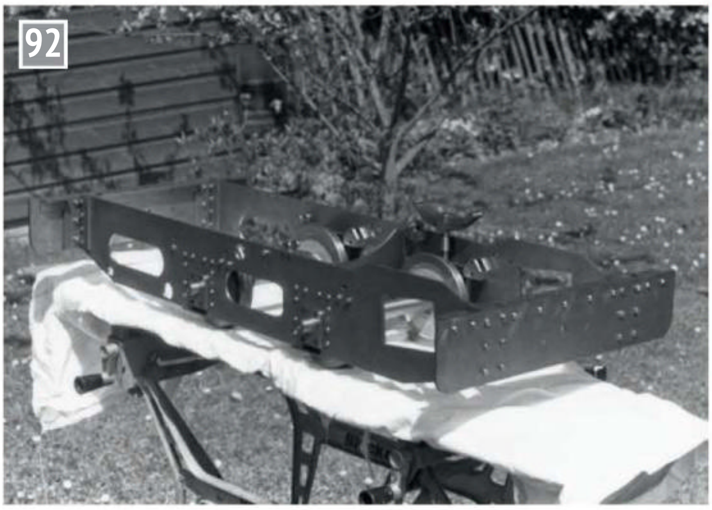
Hefty lumps

Now you, dear Reader, may recollect from the last episode that, before fully committing to this latest project, I had spent time planning how I would go about machining those cylinders, for they were the largest and heaviest components of the engine by far. And, if you cast your mind back even further, you may also recall that, while my workshop contained a capable lathe with many useful accessories, at roughly the same size as a Myford ML7 it was certainly not a large lathe and, having been built in 1905 or thereabouts, it was, to put it mildly, old. And, furthermore, you will no doubt realize that, having no milling machine, if something couldn't be machined on the lathe, or drilled on the benchtop drill press, then it had to be sawn, chiselled and filed by hand.

In summary, and taken as a whole, these were the moccasins in which I was walking.

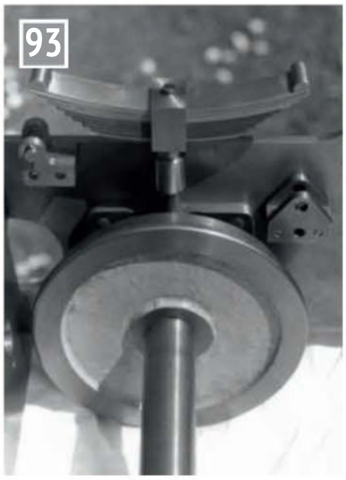
Dusting off my notes from the planning session of the previous year, and with the castings now in hand for ultimate confirmation, I began to re-check each step of the machining sequence to ensure I had not dropped any clangers, and to confirm that the castings would actually fit on the lathe as intended, and to check that

92



By the beginning of the 1986 summer holidays, Elidir was up on her wheels.

93



One of the leaf springs, finished and mounted in its buckle.

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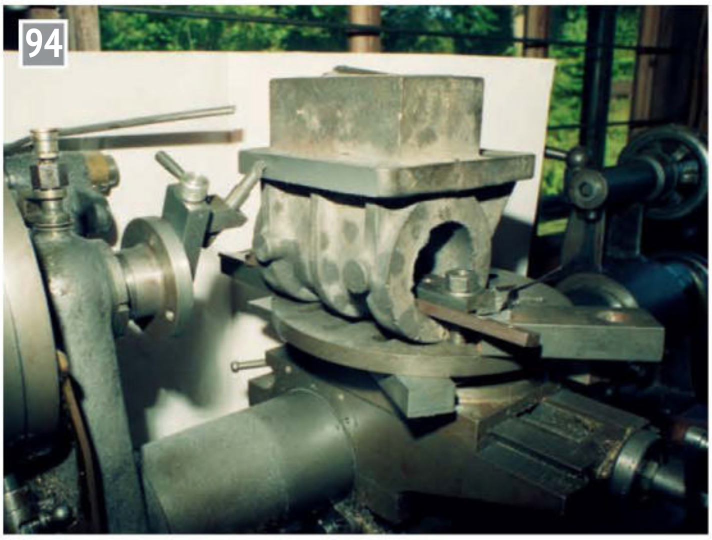
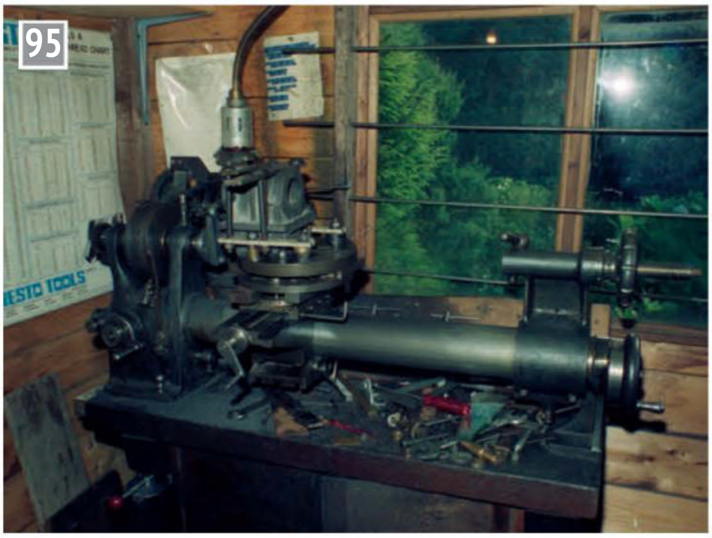


Machining begins on the first of Elidir*'s cast iron cylinders.*



The author's elderly George Adams lathe sits in his Crowborough workshop, an Elidir *cylinder casting bolted on top.*

they could be mounted and securely held as envisaged. And, fortunately, with a few minor tweaks to accommodate the heavier-than-expected lumps of iron, the original plans appeared sound.

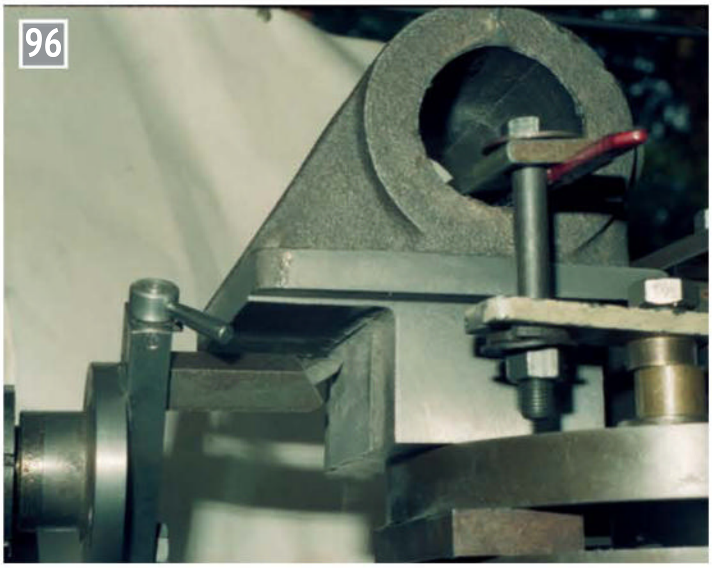
And so, with a rough sketch as a guide, I made an adjustable fly-cutter, wiped as much oil from the lathe as I dared to prevent the cast iron dust from sticking, hefted the first cylinder casting onto various packing-pieces attached to the lathe saddle, bolted it in place, put the lathe into its slowest back-gear speed and gingerly took the first cut (**photo 94**).

Before too long, with the drain-cock bosses and the lower edge of the flanges machined flat and ready to act as the mounting surfaces for the second operation, each cylinder was ready for the next setup. And so, with the packing reconfigured and the first casting re-mounted and clamped securely through the bore, the long task of machining the rest of each casting could begin in earnest - **photo 95** and **photo 96** hopefully provide an idea of the scale of the job relative to the size of the lathe. And, while some of the packing and bolting arrangements may look precarious to those readers more familiar with substantial milling machine tables and large vices, I can assure you, nervous Reader, that nothing was left to chance, each setup was solid and secure, and the entire job was finished without mishap. In fact, to my surprise, it all went rather well!

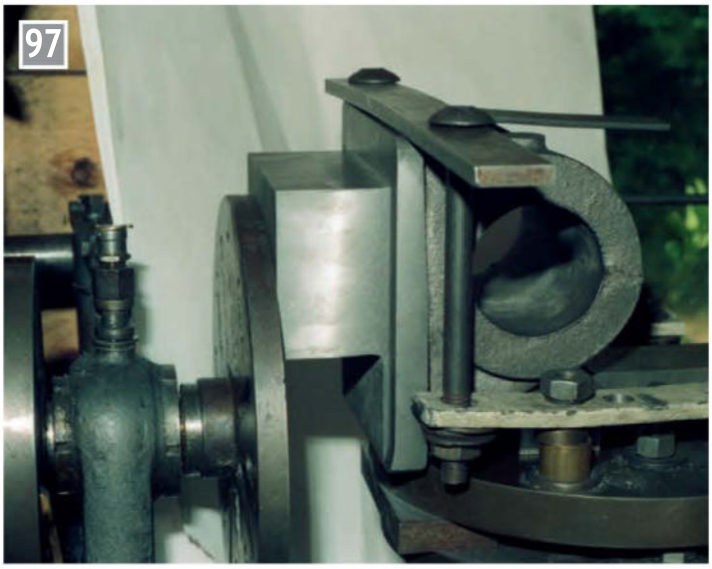
Even better, with the squareness of each setup painstakingly established using a large and rigid faceplate mounted on the lathe spindle (**photo 97**), a method of which I'm particularly fond, as each machining step for each cylinder was completed and the results carefully checked with engineer's square, vernier calipers and height gauge as appropriate, to my admitted amazement I could find neither out-of-squareness nor significant inaccuracy as the work progressed.

And so, with the port faces and mounting flanges finished and square, and the crosshead-end of the first cylinder block faced to length with the fly cutter, I mounted a catch plate to the lathe spindle, inserted my largest between-centres boring bar through the cylinder itself, attached a drive-dog to the bar, and prepared to machine the bore in the time-honoured way. And about half-way through the first cut, the sound emerging from the hole suddenly changed from the pleasant *snick-snick-snick* of a nice sharp tool happily cutting is way through grey cast iron to the ominous *mrrring-mrrring-mrrring* of a dull tool which has had enough for the day. Winding the cylinder away from the cutter I stopped the lathe and surveyed the situation.

Sure enough, even a cursory glance showed that the high-speed-steel tool in the boring bar, while originally keenly ground to a knife-edge, was now rounded and blunt.



The adjustable flycutter machines the large iron castings.



A sturdy faceplate establishes and confirms squareness at each step of the process.

Slackening the grub screw I removed the tool, returned it to sharpness with the bench grinder, and replaced it for another attempt. Restarting the lathe, I wound the cylinder back along the tool and continued the cut, but, after no more than twenty seconds of this, that ominous *mrrring* sound began to emerge from the hole as before. Puzzled, I inspected the recently sharpened tool once again, and saw, to my dismay, that it was already completely blunt.

Now what on earth was going on? Removing the boring bar from the cylinder I shone a light down the hole and, peering inside as best I could, noticed that there, right at the point where the cut had been twice abandoned, patches of the newly machined cast iron, rather than having the uniformly matt grey appearance that I expected, glittered brightly as if polished. Now that's strange, I thought, and departed the shed to do some research.

Chilling out

Now Bob, my good friend and mentor, had recently retired from model engineering and divested his well-equipped workshop and, while I could not afford to buy more than a handful of small items from his collection, he had very kindly presented me with several excellent reference books as a gift. And one of those books, or at least a few of them because they were a three-volume set, was the first edition of *Engineering Workshop Practice*, an elegantly bound compendium published in 1936 by Caxton, together with a booklet of eleven coupons entitling the owner to receive *'…free advice from the Engineering Workshop Practice Information Bureau in reply to one enquiry…'*. And, while he doubted that the offer of free advice was still available given the fifty years since the book's publication, Bob felt that I would make good use of the volumes regardless. And, having read them from cover to cover by the time I came to machine *Elidir*'s cylinders, I knew he was correct.

And so, searching the index, I found what I was looking for on page 24 of Volume III under the unambiguous heading: '*Cutting Chilled Cast Iron*'. And there, to quote directly from the book, it informed me that *'…chilled cast iron is generally a very difficult material to machine, as the 'skin' is frequently harder than tool steel'*, a fact which I'd already discovered on my own. Fortunately however, it went on to advise that it was possible to machine this pesky material with tungsten-carbide tools and that is what I wanted to know.

Unfortunately, while I now knew how to solve the problem, I did not have any such tools in my arsenal and so, after removing as much of the pervasive iron dust from hands and arms and face as I could, and with a quick phone call to check that Barry had some in stock, I extracted my bike from the garage and began the long pedal to Rotherfield, the new location of TBSITW, in search of a suitable carbide-tipped lathe tool to complete the job.

And the next morning, having purchased two similar tools just in case, and a green grit grinding wheel to sharpen them when needed, and after making the necessary modifications so that one of the tools would fit into the boring bar, I returned to the lathe and, with bated breath, began where I had left off.

And my goodness, what a difference that tool made! In no time at all, or so it seemed, the first cylinder's bore was to size and, after replacing it with a back-cutting tool to machine the opposite end of the casting squarely to length, that cylinder was removed, its identical twin mounted in its place, and the job repeated once again. And a week or so later, with the ports and passages cut and the flanges and webs laboriously filed to shape, I pronounced both cylinder castings largely complete.

A successful summer

By the end of that summer, the cylinder blocks, together with their steam chests, valves, covers, glands and whatever else I have forgotten, were all finished and mounted proudly on the chassis which, in protest at all the front-end weight, had, like Robin's tram, adopted a decidedly nose-down attitude.

Of course, having spent the best part of six weeks reducing the castings to their final dimensions, and with plenty of time for my mind to wander in the meantime, a few more '*What if?*' moments had occurred along the way.

As a result, each steam chest now sported an additional tapped hole at its lowest point in readiness for an extra drain cock which, I reasoned, would be a worthwhile addition to help warm the cylinders at the start of each run and prevent rust by allowing condensate to be drained from the otherwise sealed iron box at the conclusion. After all, if I was going to make four drain cocks I might as well make six, and if I was to make one set of linkages back to the cab then I might as well make two.

Furthermore, and in a more radical departure from the design, I had decided to rotate each valve chest cover through 180 degrees from the drawings, thereby repositioning each cylinder's steam-pipe connection behind the blastpipe rather than in front. This, I believed would provide more flexibility at these flanged joints and reduce the chance of leaks when everything expanded and contracted with the heat, something I saw as a potential flaw in the as-drawn design.

But further implementation of these aspirational plans would have to wait because, sadly, the summer holidays were once again over, my final year of A-level studies was about to begin, and I knew beyond doubt that I would have little time for model engineering in the meantime. And so, having removed as much of the lingering cast iron dust as I possibly could, and after giving the workshop's contents, including the now-much-heavier *Elidir* chassis, a good coating of oil to help keep rust at bay, I turned off the lights, locked the door and set my alarm clock for ten-to-five in readiness for a rude awakening the next morning.

Postscript to Part 16

The well-known quotation at the start of this episode, although it's actually a misquote but let's not be too picky, comes from the poem *Judge Softly* by Mary Torrans Lathrap, a Michigan-born '…poet, preacher, suffragist and temperance reformer' (according to Wikipedia) and an absolute riot at parties (according to me, but I made that bit up).

Anyway, on a seemingly unrelated topic, several years ago my daughter graduated from middle school and departed to begin her high school education and, in line with the tradition in these parts, during that final middle-school year, her school produced a yearbook, a hardbacked tome filled with pictures and memories and anecdotes from each member of the graduating class, which was presented to each student at the graduation ceremony.

And flicking through that book one day, I came across a page devoted to quotations, each graduating student having contributed their favourite, and my eye was drawn to the choice of Thomas, a boy I knew well and a budding engineer to boot, who had selected the self-same paraphrased words from *Judge Softly* with which I began this episode.

However, Thomas, to my even greater delight, went one better and added his own addendum to the traditional text, and I leave you with his version which still makes me laugh each time I read it:

'Never judge a man until you've walked a mile in his moccasins.

Because then you're a mile away from him.

And you have his moccasins.'

Thank you, Thomas.

●To be continued.

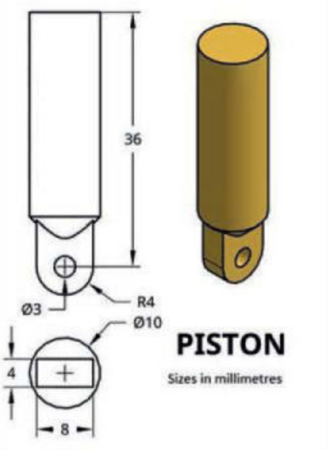
Basic Oscillator Steam Engine in CAD

PART 4

Luis Trincão takes us through the CAD process step by step.

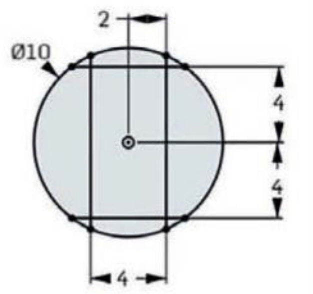
Continued from p.747
M.E.4718 June 2

Fig 49



Piston drawing.

Fig 50



Piston sketch.

Piston

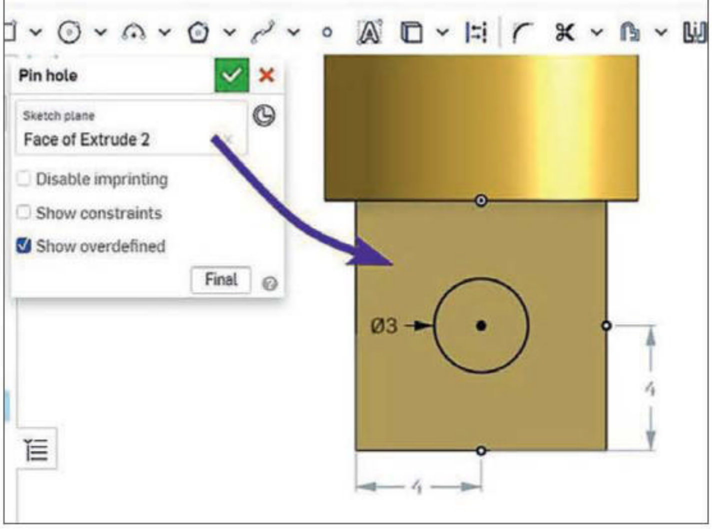
The next part is the piston. If you've been able to create the previous parts, it will be easy (**fig 49**).

Step P1 – Create a Part Studio and make the sketch of **fig 50** on the Top plane. Use the Trim tool to remove all segments not needed from the rectangle construction.

Step P2 – Extrude-New 32mm to create the cylindrical shape of the piston.

Step P3 - Extrude-Add 8mm of the sketch rectangle in the opposite direction to the previous step.

Fig 51



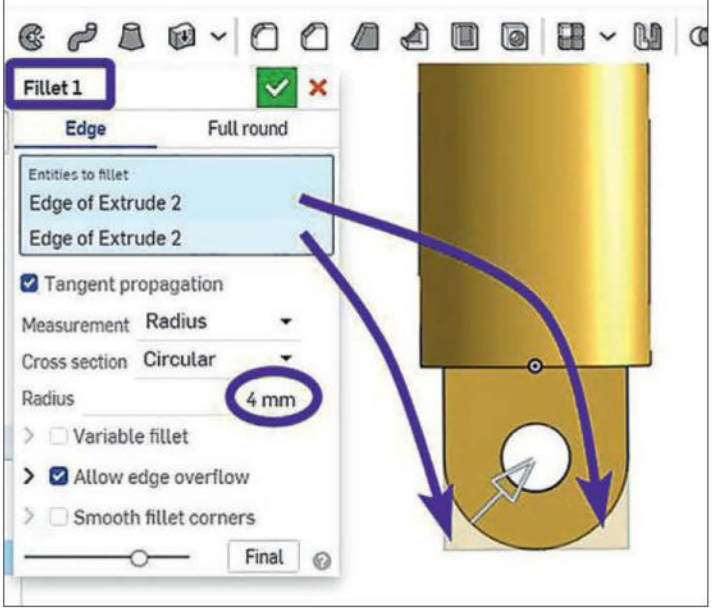
Pin hole

Sketch plane
Face of Extrude 2

☐ Disable imprinting
☐ Show constraints
☑ Show overdefined

Piston hole.

Fig 52



Fillet 1

Edge | Full round

Entities to fillet
Edge of Extrude 2
Edge of Extrude 2

☑ Tangent propagation
Measurement: Radius
Cross section: Circular
Radius: 4 mm
☐ Variable fillet
☑ Allow edge overflow
☐ Smooth fillet corners

Piston fillet.

Step P4 – Create a sketch for the crankpin hole – **fig 51**.

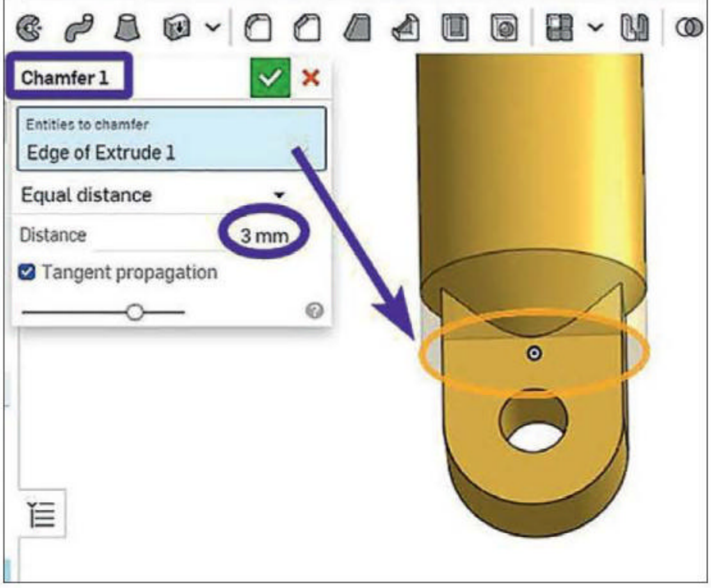
Step P5 – Extrude-Remove to create the crankpin hole. The Hole tool could be used instead.

Step P6 – Use the Fillet tool to create the shape in **fig 52**.

Step P7 – Use the Chamfer tool as indicated in **fig 53**.

Step P8 - Name your part, set the material and colour.

Fig 53



Chamfer 1

Entities to chamfer
Edge of Extrude 1

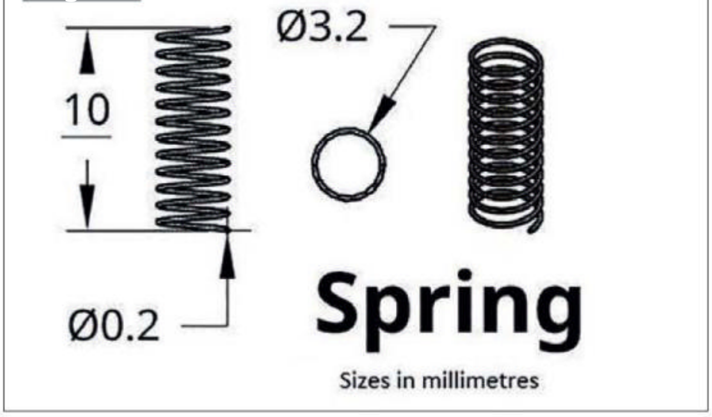
Equal distance

Distance 3 mm

☑ Tangent propagation

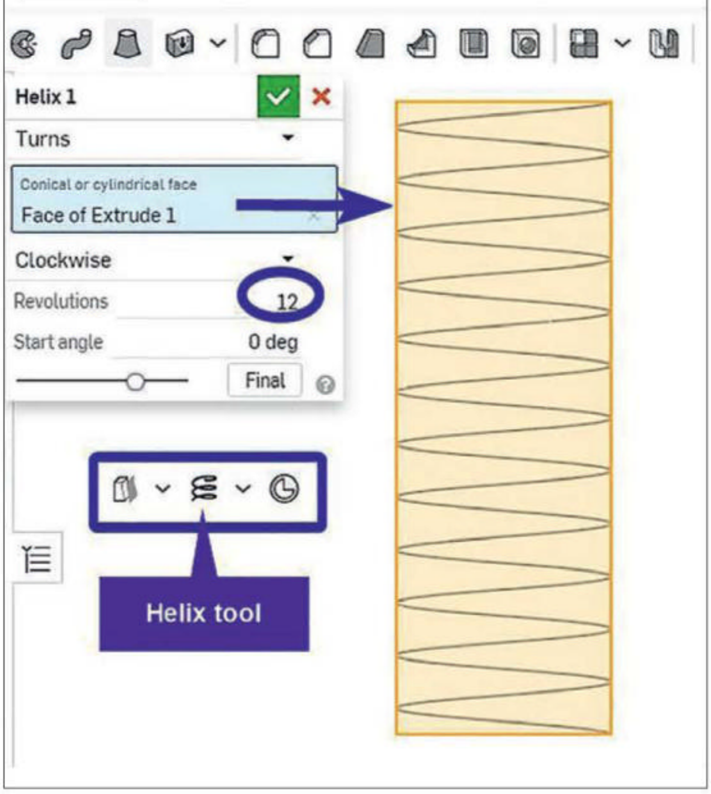
Piston chamfer.

Fig 54



Spring.

Fig 55



Helix 1

Turns

Conical or cylindrical face
Face of Extrude 1

Clockwise

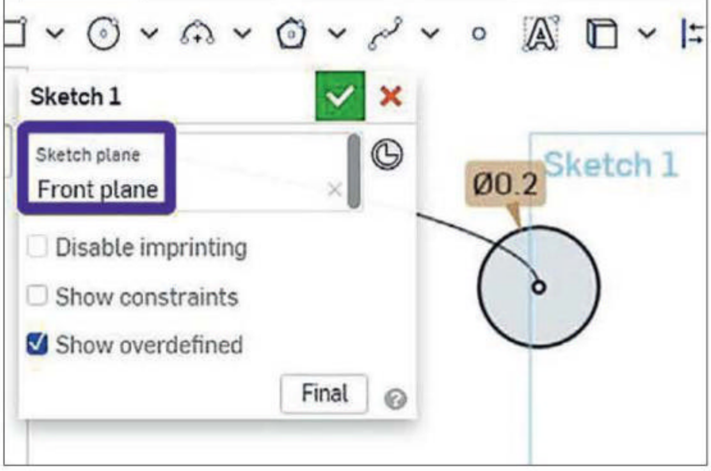
Revolutions 12

Start angle 0 deg

Final

Helix tool.

Fig 56



Sketch 1

Sketch plane
Front plane

☐ Disable imprinting

☐ Show constraints

☑ Show overdefined

Final

Helix section

Steps P6 and P7 are not essential to make our engine work in CAD but they improve the appearance.

Spring

Now we go on to create the spring – **fig 54**. You will need to use tools not yet explained in this article. I recommend watching the video accessible via QR Code 8 or searching 'Onshape Spring' on the Internet.

www.youtube.com/watch?v=_jNx9sOcBU8&t=89s

The sketch process uses an auxiliary cylinder. Around it, a helix is created. Then you sketch the section of material (wire), usually a circle. Finally, use the Sweep tool to generate the spring. Explaining step by step:

Step S1 – Create a Part Studio and create a sketch on the Top plane with a 3.2mm diameter circle.

Step S2 - Extrude-New 10mm to build the auxiliary cylinder.

Step S3 – Use the Helix tool around the auxiliary cylinder face. There are several parameters to define the helix. I chose the configuration of **fig 55**.

Step S4 – Create a sketch on the Front plane. This plane will contain the starting point of the helix. Draw a circumference of 0.2mm diameter – **fig 56**.

Step S5 – Use the Sweep command to create the spring – **fig 57**.

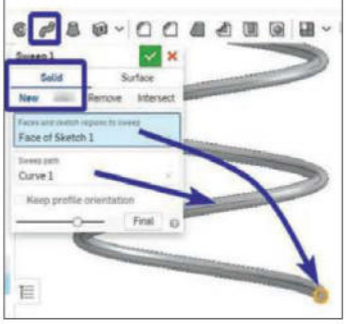
Step S6 - Name your part, set material and colour.

In the Parts menu appears the auxiliary cylinder for the construction of the helix and a part named 'Sections', which corresponds to the spring.

Your last part, the spring, is created.

●To be continued.

Fig 57



Sweep 1

Solid Surface

New Remove Intersect

Faces and sketch regions to sweep
Face of Sketch 1

Sweep path
Curve 1

Keep profile orientation

Final

Sweep.

LNER B1 Locomotive

PART 22 – VALVE LINERS

143

Gratuitous photo of yet another B1.

Doug Hewson presents an authentic 5 inch gauge version of Thompson's B1 locomotive.

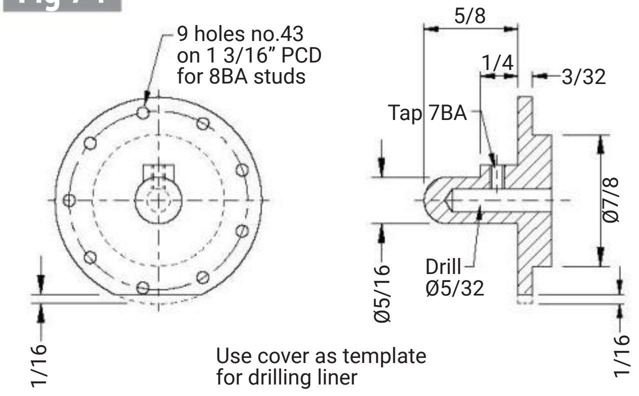
Continued from p.739, M.E.4718, June 2

I thought that this was a nice photo of a B1 61240 *Harry Hinchcliffe* photographed at Saltburn in North Yorkshire in 1955 (**photo 143**). I had put this photograph to one side as it shows the front bogie to advantage. It is the third type of bogie fitted to the B1s, as shown earlier in the series. It has the generator on the right-hand foot plate and both Dave Noble and Mike Jack make a lovely casting for these.

This time I want to describe how I made the valve liners and other bits and pieces to go with them (**figs 74** to **77**).

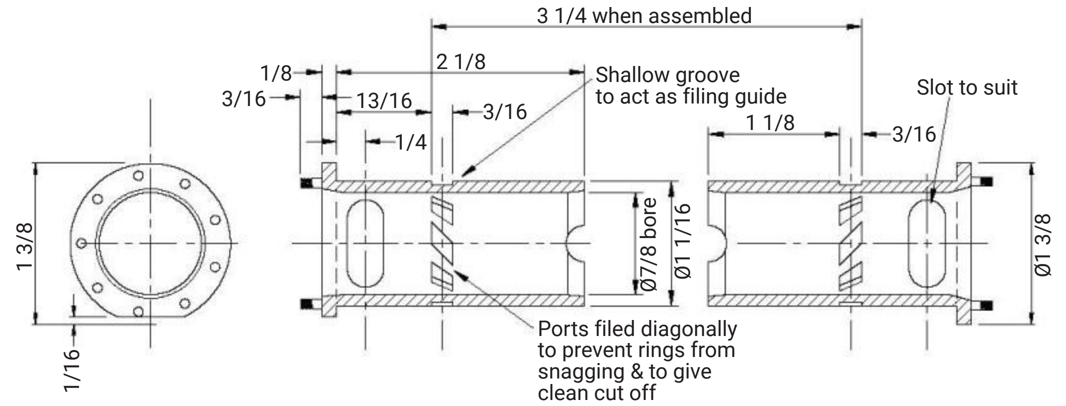
First of all, you need a good 1½ inch stick of Mehanite cast iron bar. This needs turning down to 1⅜ inches diameter and then turn down a 2⅛ inch length to about a thou under 1 1/16 as that should just give you enough room to Loctite them in. However, before you do, I always like to turn a 3/16 inch groove 1⅛ inches from the end where you push the liner in

Fig 74



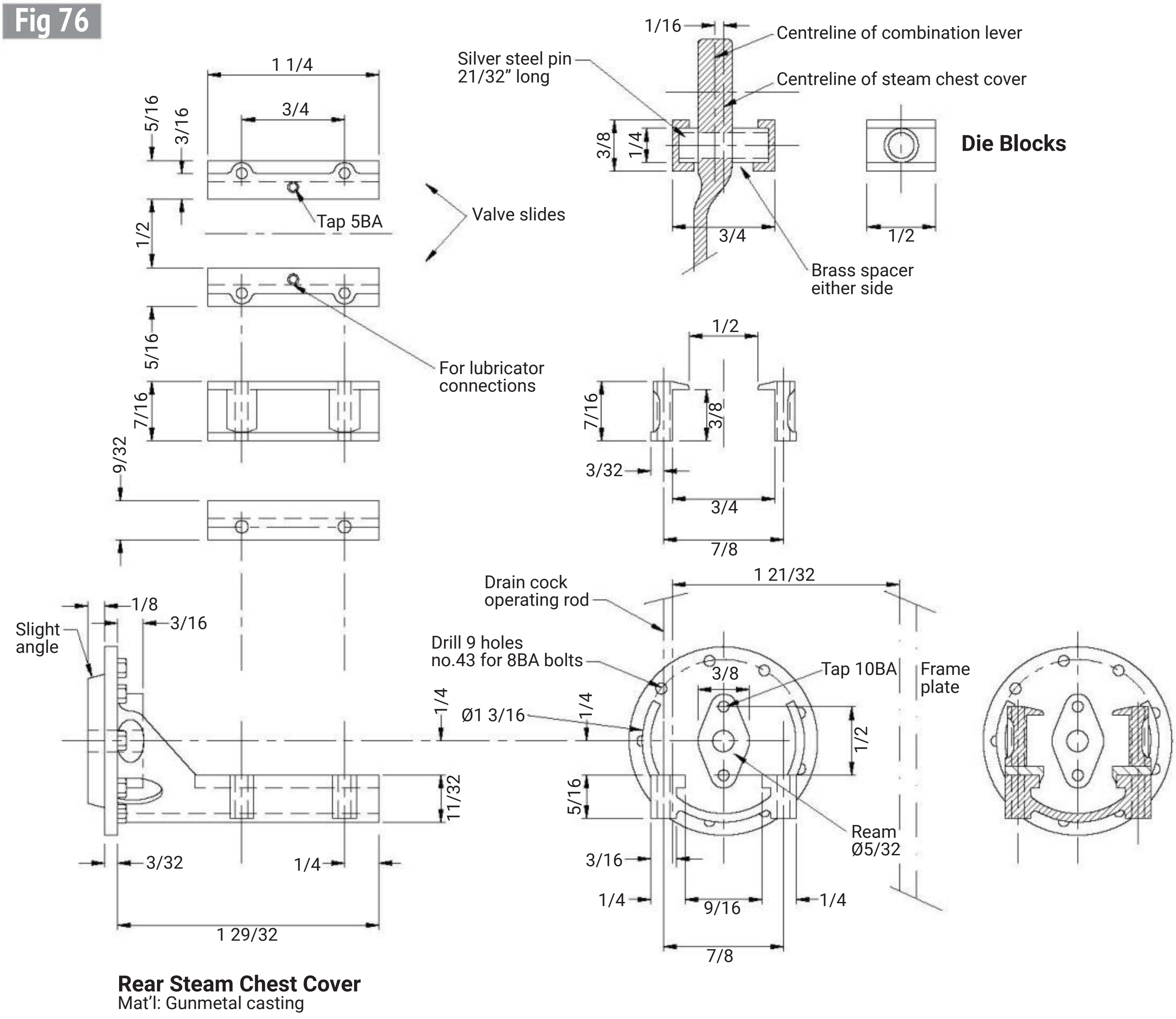
Front steam chest cover.

Fig 75


3 1/4 when assembled
2 1/8
1/8
3/16
13/16
3/16
1/4
Shallow groove to act as filing guide
1 1/8
3/16
Slot to suit
1 3/8
1/16
Ø7/8 bore
Ø1 1/16
Ø1 3/8
Ports filed diagonally to prevent rings from snagging & to give clean cut off

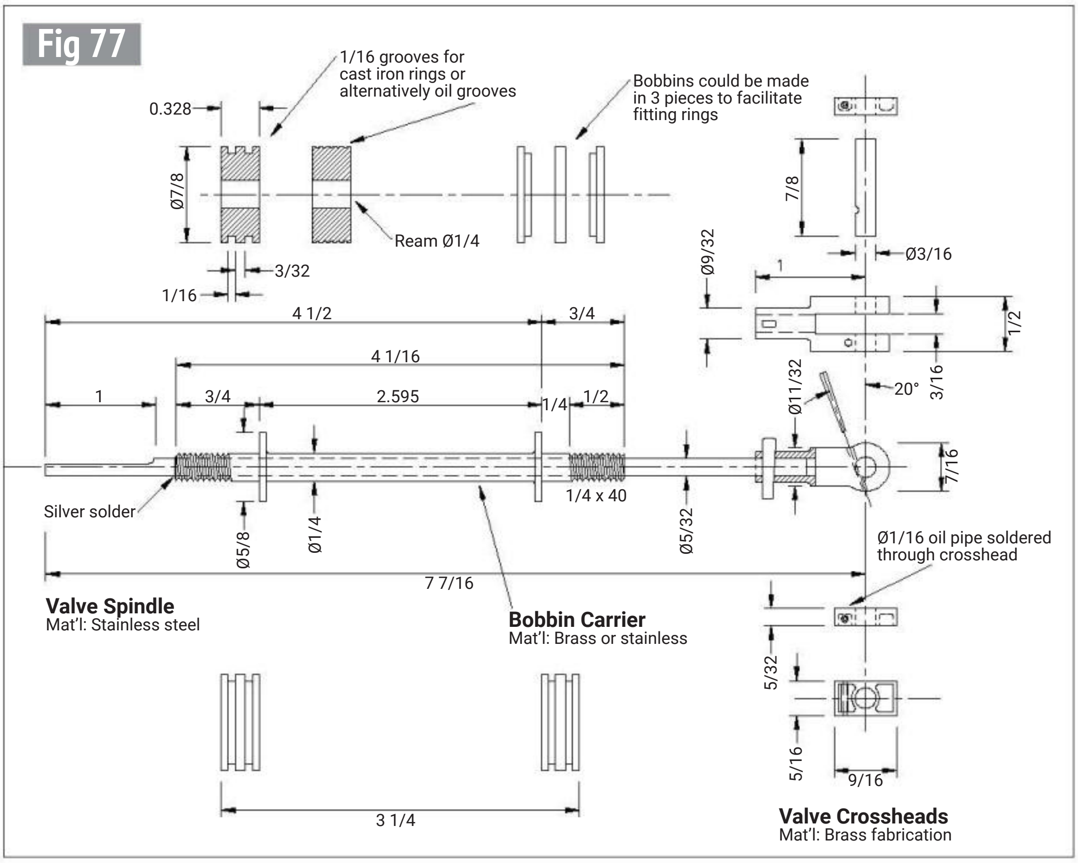
Valve liner.

Fig 76


1 1/4
3/4
5/16
3/16
Tap 5BA
1/2
Valve slides
5/16
For lubricator connections
7/16
9/32
1/16
Centreline of combination lever
Silver steel pin 21/32" long
Centreline of steam chest cover
3/8
1/4
3/4
Brass spacer either side
1/2
Die Blocks
1/2
7/16
3/8
3/32
3/4
7/8
Slight angle
1/8
3/16
Drain cock operating rod
1 21/32
Drill 9 holes no.43 for 8BA bolts
3/8
Tap 10BA
Frame plate
1/4
Ø1 3/16
1/4
1/2
11/32
5/16
Ream Ø5/32
3/32
1/4
3/16
1/4
9/16
1/4
1 29/32
7/8
Rear Steam Chest Cover
Mat'l: Gunmetal casting

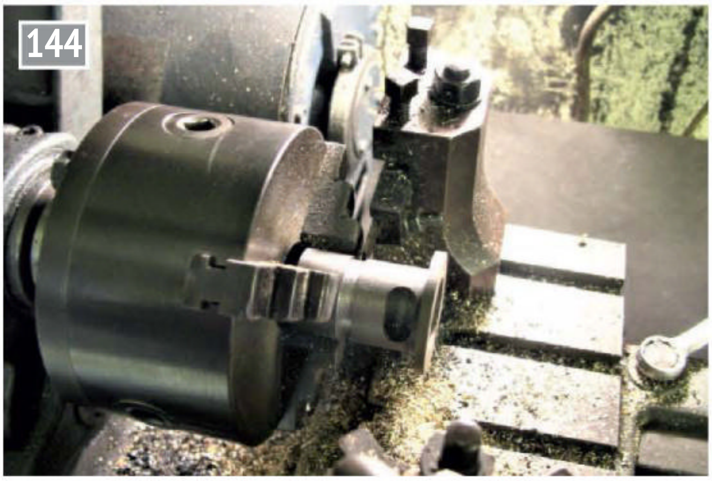
Rear steam chest cover.

Fig 77


1/16 grooves for cast iron rings or alternatively oil grooves
Bobbins could be made in 3 pieces to facilitate fitting rings
0.328
Ø7/8
Ream Ø1/4
3/32
1/16
4 1/2
3/4
4 1/16
1
3/4
2.595
1/4
1/2
Silver solder
1/4 x 40
Ø5/8
Ø1/4
Ø5/32
7 7/16
Valve Spindle
Mat'l: Stainless steel
Bobbin Carrier
Mat'l: Brass or stainless
3 1/4
7/8
Ø3/16
1
Ø9/32
1/2
Ø11/32
20°
3/16
7/16
Ø1/16 oil pipe soldered through crosshead
5/32
5/16
9/16
Valve Crossheads
Mat'l: Brass fabrication

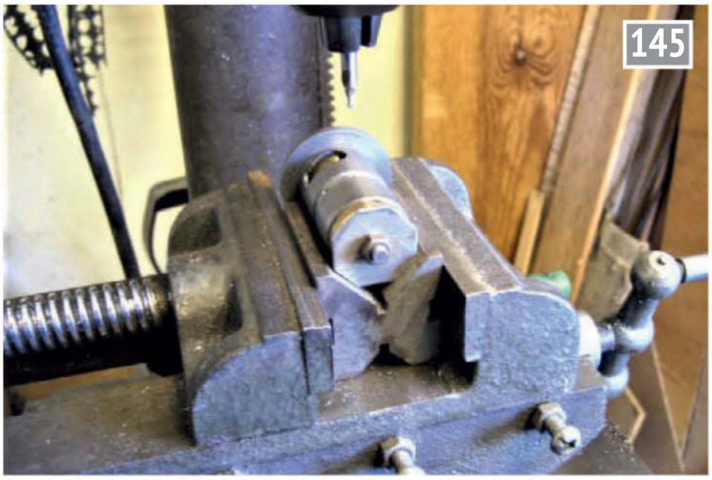
Valve spindle.

144



Machining a groove for the lozenge shaped holes.

145



Drilling holes to position the lozenge shapes.

from. This will give you a filing groove to shape the steam inlet vents a lozenge shape. This is not only because that is how the full size ones are but also to hopefully to prevent any snagging of the rings on the port edges. The flanges also need drilling with nine No. 43 holes at 19/32 pitch circle diameter.

Now back to those lozenge shaped slots. **Photograph 144** shows me cutting the groove around the valve liner so that I could use it as a guide for filing the drillings into those lozenge shaped holes. Note also the slot for the exhaust towards the end of the liner. The liner was fixed in with a good pasting of Loctite and the two halves had to be carefully aligned with the exhaust port. Also, the inlet ports in the liners need to be matching the cylinder block so that everything lines up. **Photograph 145** shows me drilling the holes with my little template I used for aligning the eight holes for drilling. **Photograph 146** is my method of filing the ports to that lozenge shape which I keep going on about. I don't know whether this makes any difference to the actual performance but that is how they are on the full-size engine so that is how they had to be on my own engine!

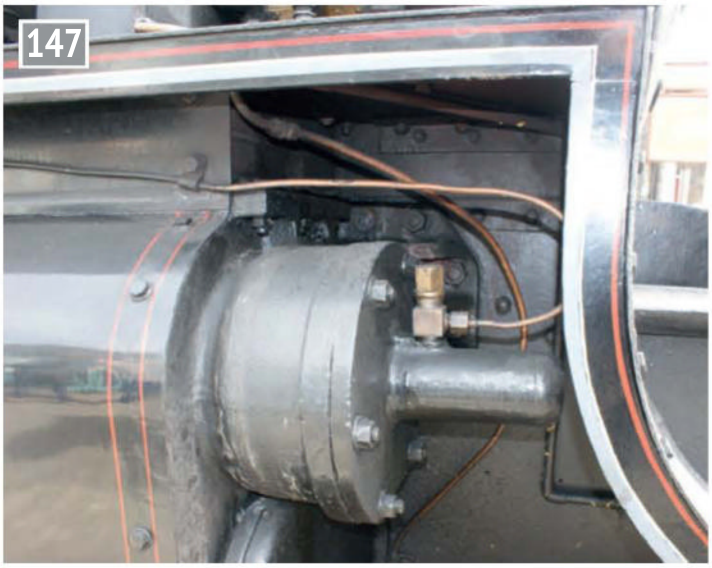
146

Filing out the lozenges.

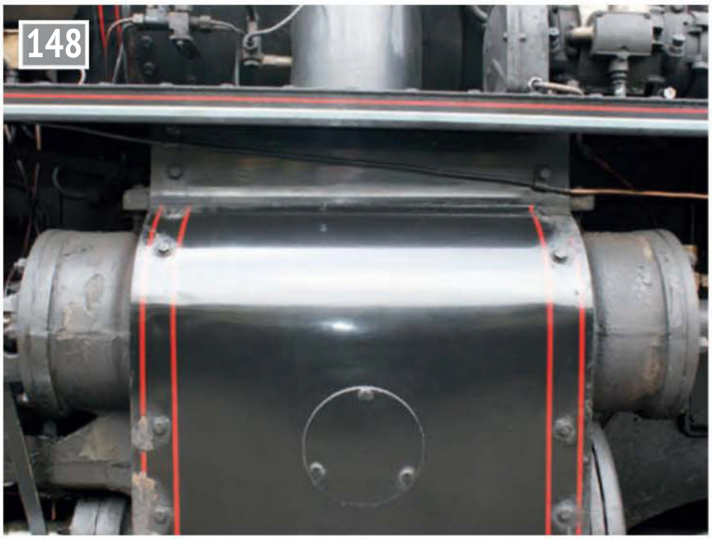
Now if you have a look at my drawing of the front steam chest cover (fig 74) you will see there is a small tapping 7BA which is for an oiling point for the valve tail rod. This has a pipe from the rear of the oil box just in front of the steam pipe entrance to the cylinder. There are two pipe clips for this pipe which slope up gradually to this swab box. **Photograph 147** shows this oiling point and **photo 148** shows the continuation of the oil pipe.

Photograph 149 shows the drain cock rod passing through the rear steam chest cover so this is another thing which needs very careful alignment but as a guide you can use one of the holes to fix the cover as the hole at the rear stud is dead in line across the centre, but that is the only one.

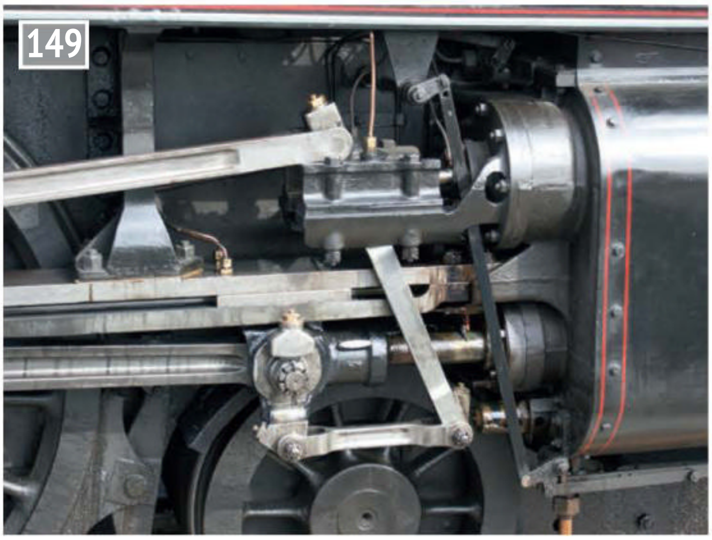
The rear steam chest cover should ideally be a lost wax casting. However, if anyone feels the need to make their own you can - just add 4% to all the dimensions and it will be done. The only thing is that you will need to also make another one opposite hand! This is much easier if you have access to a 3D printer, or if one of your mates has access to one. You need to ask advice on this about the shrinkage. Whoever makes the pattern also needs to make the patterns for the left and right-hand valve guides. It would make life much easier! Essentially the rear covers are circular in section with various holes cut out of them!


147

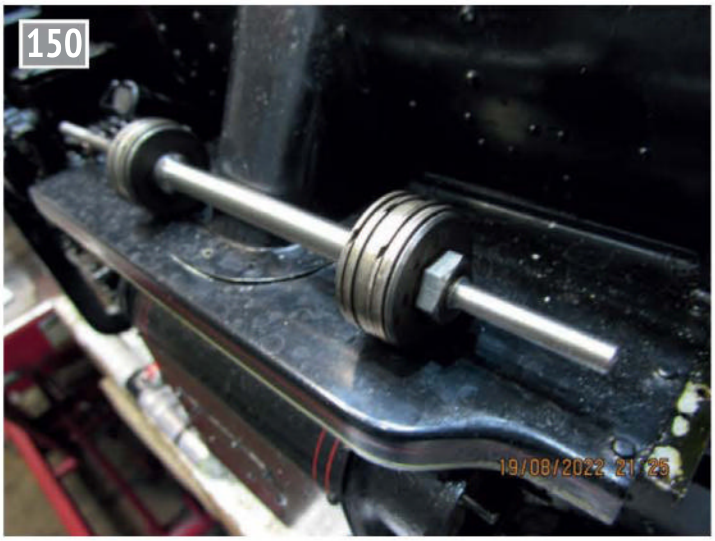
Valve tail rod oiling point.


148

Path of the oil pipe.


149

Drain cock linkage.


150

Valve tail rod oiling point.

151

A stick of die blocks.

Now, for some time I have been in conversation or by email with Eddie Gibbons on Tyneside who has been commissioning my 4MT, so before I get into making the piston valves, I will present the drawing as I had originally drawn it. Eddie is much in favour of fitting proper rings on his engines, so he has made new piston valves with four rings on each bobbin for my 4MT. He has now removed 30 thou from the outer ends of both bobbins which has given the engine just a little bit of lead and now says that it has given the engine its 'chuff' back. **Photograph 150** shows my new valves and that was another transformation to my engine.

The valve spindles are really just a plain turning job but if you do want to make the engine chuff a bit then you will need to reduce the length of each bobbin by 30 thou. The spindle is held into the yoke at the rear end and is held in by a vertical key. You will also need to fit a taper pin at an angle of 20 degrees to hold the pin in place. I made the die blocks as two sets of four but I am afraid that the only photograph of that which I have (**photo 151**) is rather blurred so I just hope that the powers that be might have a better way of making them a bit better so that at least you can get the message! I have also shown 1 inch of flat on the tail end of the spindle so that you do not get any compression in the tail rod gland otherwise it might blow bubbles in the oil box.

●To be continued.

NEXT TIME

We make the cylinder covers and drain cocks.

Railway Braking for Model Engineers

PART 3

Bob Bramson explains the important business of bringing trains to a halt in a controlled manner.

Continued from p.771
M.E.4718 June 2

How to go about designing a brake installation – calculations

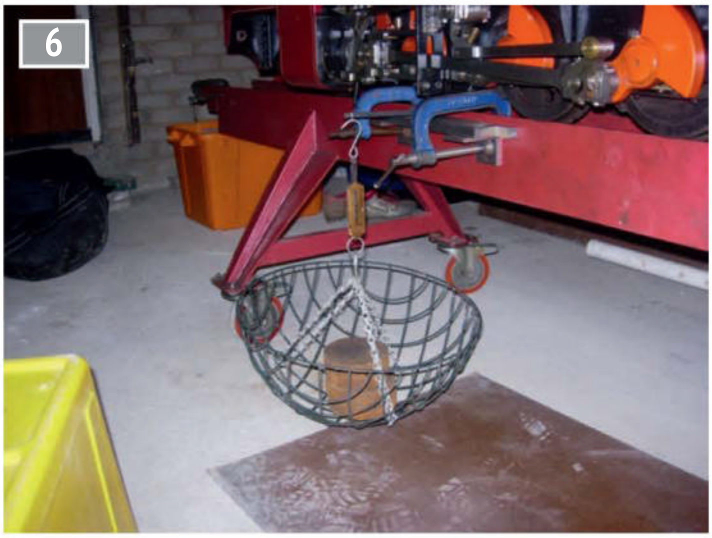
All engineering is a combination of the theoretical and the practical. It is senseless just to pitch-in and make things without first planning what has to be achieved and how to do it.

The steps in designing a brake installation are straight forward and involve the following:

* Firstly – establish each individual wheel load, by estimation, calculation or actual weighing. It is worthwhile to actually weigh the wheels using a simple forked end lever at the wheel rim, fulcrum, spring balance and a series of weights (**photo 6**), taking care to eliminate any 'stick-slip' at the axleboxes by inching the locomotive backwards and forwards a few times.
* The next thing to do is to select the 'brake percentage'. A value of 70 to 80% is normal for a locomotive or the loaded tender (where the driver sits upon it) but a suitable lower value, possibly up to 50% may be used for coaching stock where the load is variable.
* The brake force is next calculated taking into account the total wheel loads and brake percentage.
* With this information, the brake lever ratio is selected by reference to the layout of the rigging in relation to the design of the locomotive or rolling stock. Where compensated rigging is employed, it is usual to set it up for equal brake force on each wheel. It may entail some experimentation to achieve equal loads since angular displacements of the pull rods introduce errors.
* Before the brake cylinder diameter is calculated, it is necessary to decide on the effective working pressure of the system. For a vacuum brake, 21 inches Hg is desirable providing a maximum pressure of 10 lb/in^2 whilst for air brakes a working pressure of say 20 lb/in^2 is safe and adequate.
* Then calculate the brake cylinder diameter.

The following worked example is included to assist in doing the maths:

* Let us assume a Pacific locomotive with only 6 of the 12 wheels braked.
* So, if say the loco weighs 1,000 lb it is likely that



'Weighing' the wheel loads of a large 7¼ inch gauge locomotive.

the load on the braked wheels may be only 600 lb (establish by weighing).

- The overall lever ratio works out at 6:1.
- The maximum brake cylinder pressure is 10 lb/in^2.
- The efficiency of the brake linkage is assessed at 80%.
- The brake percentage is set at 70%.

So, we have:

Brake Force = 0.7 x Wheel Load
Brake Force = 0.7 x 600 = 420 lb
Brake Force = Area of Piston x Pressure x Lever Ratio x System Efficiency, so
Area of Piston = Brake Force / (Pressure x Lever Ratio x System Efficiency)
Area of Piston = 420 / (10 x 6 x 0.8)
Area of Piston = 8.75 in^2
Diameter of Piston = $\sqrt{(8.75 \times 4 / \pi)}$ = **3.33 in.**

Use the nearest larger available piston seal diameter, in this example **3.375 in.**

Stopping distance

It is somewhat academic to calculate the stopping distance because you 'have what you have!'. However, on straight and level track, a locomotive and train in 7¼ inch gauge typically should be capable of stopping from 10 mph in about 60 feet. The effects of gradients either up or down is, of course, very pronounced, especially with a fully laden train.

It is possible to compute the approximate stopping distance and a reasonable estimate can be assumed using a uniform deceleration rate. Once the total vehicle mass and brake force has been determined, the uniform deceleration rate can be calculated. From this, the stopping distance on level track can be predicted but it must be accepted that this is an approximation. It is better to establish the braking distance by actual experiment.

So, we start with:

Force = Mass x Acceleration where Force *f*, is in lb (we model engineers like Imperial measurements…).

Mass *m* (**caution** here - mass is in 'slugs', which is weight in lbs/32.2).

Acceleration *a* is in ft/sec^2

The graph in **fig 17** illustrates two curves. The black line is uniform deceleration and the coloured line, an estimate of the more likely rate of stopping.

From experience in 7¼ inch gauge, it seems practicable to design for higher deceleration rates since the initial speeds are low and friction is enhanced.

As an example, the following is included to assist in doing the maths:

Assuming the Pacific locomotive example in the preceding section weighing 1,000 lb:

Mass = 1,000/32.2 slugs
Initial Speed (u) = 10 mph = 14.7 ft/sec
Brake Force = 420 lb
Retarding Force = μ x Brake Force = 0.2 x 420 = 84lb
Braking Factor = 1.2
$f = m \times a$, thus $a = -(84/1000) \times 32.22 = -2.70$ ft/sec^2

We use one of the kinematics equations to calculate the final speed (v):

$v^2 - u^2 = 2a \times s$, or
$s = (v^2 - u^2) / 2a$, so
$s = (0 - 14.7^2)/(2 \times 2.70) = 40$ feet

Applying the Braking Factor:
1.2 x 40 = **48 feet**.

In this approximation, the locomotive on its own would stop in approximately 48 feet. Assuming its tender was similarly braked, a train might realistically stop on level track between 50 and 60 feet. As previously outlined, the actual stopping distance is better determined by trial.

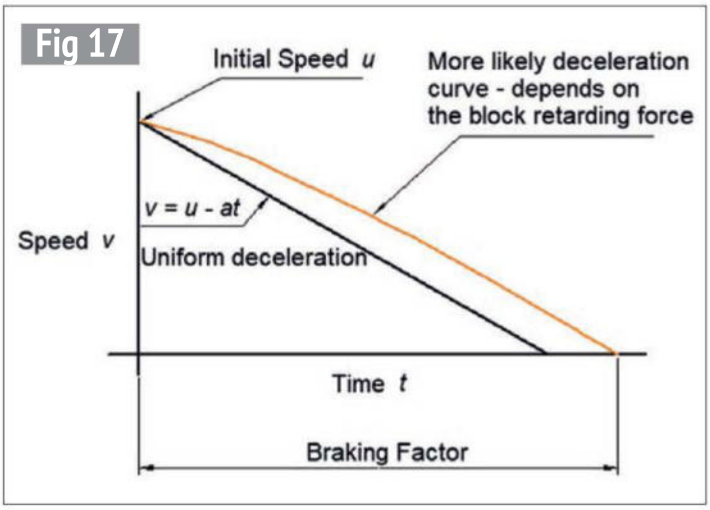
The braking curve shown in **fig 18** is typical of the work carried out by a brakes engineer for rolling stock on a main line railway. The average deceleration rate is usually measured in percentage of the acceleration due to gravity (%g). A typical service brake for a main line train would be approximately 9 %g and an enhanced (emergency) brake 12 %g (g = 32.2ft/sec^2).

Braking distance is also very dependent on rising and falling gradients. The objective is firstly to carry out testing on uncontaminated rails to confirm that the normal braking performance falls within the mandated requirements. A further test is carried out on 'lubricated' track to simulate winter climatic conditions and also to prove the wheel slide protection (WSP) devices work effectively. Each vehicle of similar rolling stock should brake at the same rate. Freight vehicles are usually fitted with variable load valves (VLVs) due to the large difference between tare (empty) and laden weights. These valves are quite intricate and usually receive their control inputs from loads on the suspensions.

Some DOs and DON'Ts!

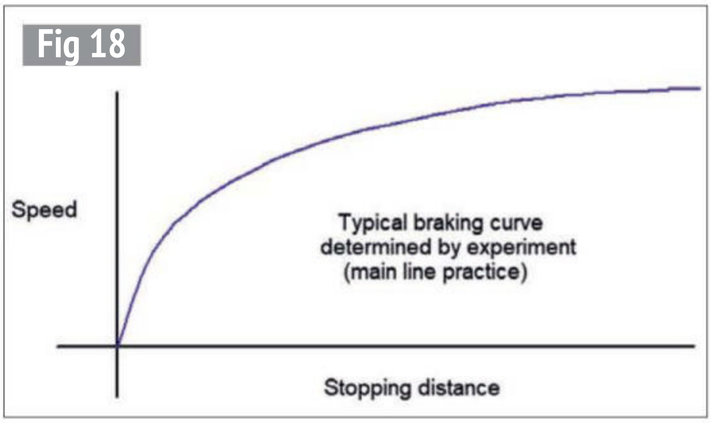
- Keep it simple!
- Do use rubber or soft seated valves.
- Do use stiff brake beams and linkages.
- Don't use cable operated brake linkages.
- Do use simple inter vehicle couplings.
- Use compressed air and solvent to remove any swarf or debris from all pipe work before fitting. Cleanliness is a virtue!
- Test every sub-system and every pipe joint before you assemble the final system. Then test the whole thing.
- Ensure that brake hanger assemblies are hung accurately to ensure that blocks do not tend to 'flange' and that there is adequate lateral clearance to allow the blocks to follow the wheels on curves.
- The blocks must be hung below the centre line of the wheel to ensure they fall away when released.
- The action of the brake force should be through the wheel centre line.
- Since the mass of the brake pistons is small, the use of return springs is necessary to help release the brake.
- Produce the very best of fits, flatness and surface finish for brake valves.

Fig 17



Deceleration assessment.

Fig 18



An example of a brake test as carried out on a main line railway.

>>

- Make provision for adjustment for wear and after wheel re-profiling.
- Always check the system effectively and carry out a brake continuity test before setting off with a train.
- Maintain the system in perfect working order at all times.
- Don't forget to drain condensate out of the system after every run

Using the vacuum brake – pre-service checks

The system must be checked for mechanical and system integrity. Ensure that the engine is set on level track and cannot roll away. If any of the pre-service checks fails to meet requirements, the cause must be established and remedied before the locomotive is passed fit for service.

Visually examine the brake linkage for any signs of damage and ensure that all cotters and split pins are in place and suitably secured. Release the hand brake and ensure that the brake blocks fall away from the wheels and that block clearances are not excessive.

Secure the tender vacuum hose on its dolly and ensure that the engine to tender flexible vacuum pipe is connected, that the driver's brake valve (DBV) handle is in the 'OFF' position and the ejector steam valve on the DBV is shut.

The brake tests may be undertaken with at least 50 lb/in^2 steam pressure available. CAUTION! Ensure that any by-standers are clear of the chimney exhaust as hot water condensate will be expelled upon first opening the ejector steam valve. Open the ejector isolating valve on the turret and then 'blow up' the vacuum by opening the ejector steam valve on the DBV. When the system is fully exhausted, the train pipe vacuum gauge should register 21 inches Hg. Ensure that the brake blocks are not applied to the wheels.

With the gauge registering 21 inches Hg. shut off the ejector. Note the time taken for the train pipe vacuum to fall to 15 inches Hg. This should be greater than 30 seconds. Open the ejector and restore the vacuum (during the initial commissioning tests, the stand-up time should be in excess of five minutes).

Make a full brake application and shut off the ejector. Note the time taken for the brake blocks to release. This should be greater than two minutes (during the initial commissioning tests, the stand-up time should be maintainable for around an hour). Return the brake handle to the 'OFF' position and restore the vacuum by opening the ejector steam valve.

Before coupling to the train, destroy the train pipe vacuum. Then, couple and 'blow up' the whole train. When the train pipe registers 21 inches Hg the guard must apply the brake at the rearmost position of the train (Standard Brake Test) and the driver should observe that the train pipe vacuum falls to between 0 and 3 inches Hg. The train should be checked to ensure that all blocks are firmly applied to the wheels. The guard closes the rear cock or replaces the vacuum hose on its dolly and the train pipe vacuum should re-set to 21 inches Hg. with the brakes released.

Photographs 7 and **8** show the brake system on one of the author's locomotives. Note that, for ease of maintenance, the brake system for the driving wheels is non-prototypical.

Using the vacuum brake - operating the brake

The art of braking a train will probably be learned over a period of time. The 'feel' of the brake is a tactile experience and takes a while to master. The effectiveness of the brake depends upon many factors - perhaps the main variable is the friction conditions at the wheel to rail and wheel to brake interfaces. All this is part of the 'feel' experience. Allow plenty of distance for service braking and always try the brake soon after setting off to ensure that the system is operating effectively, especially when rail conditions are contaminated or wet.

CAUTION! When rail head conditions are degraded (first train out or in adverse weather) make light brake applications at appropriate intervals to 'prove' the brake and to condition the wheel treads/blocks. This is known as 'defensive driving' and is good practice.

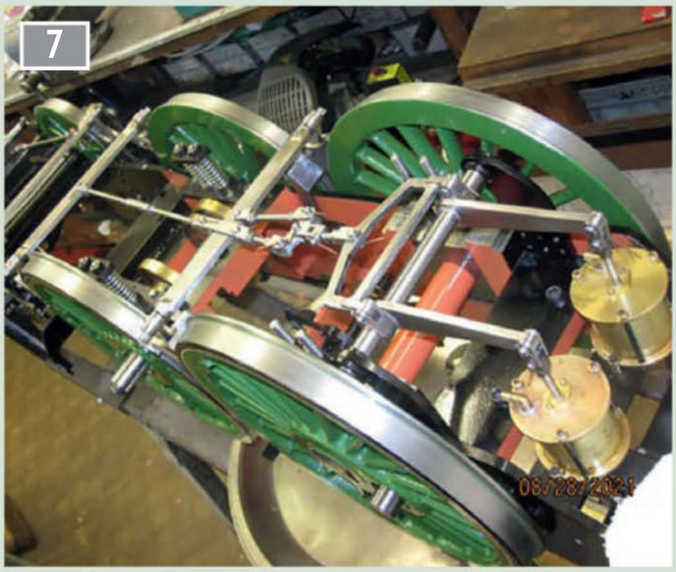
When in motion, the steam valve to the ejector must remain open at all times. It will be found that there is an optimum position for the valve opening at different levels of boiler pressure. For example, at low pressures (40 p.s.i.) the valve will be fully open. At full pressure, the valve may be almost shut. The ideal position for the valve can be established and easily set by reference to the o'clock position of the handle. This technique is the same in full size practice.

To apply the brake, the drivers brake valve handle is moved towards the driver. The power of the brake application directly relates to the degree of train pipe vacuum destroyed. Do not 'fan' the brake handle (rock it backwards and forwards) - a steady reduction of vacuum is best obtained by a gradual application. Note that on falling gradients, the braking distance will be greater than on level or up gradients.

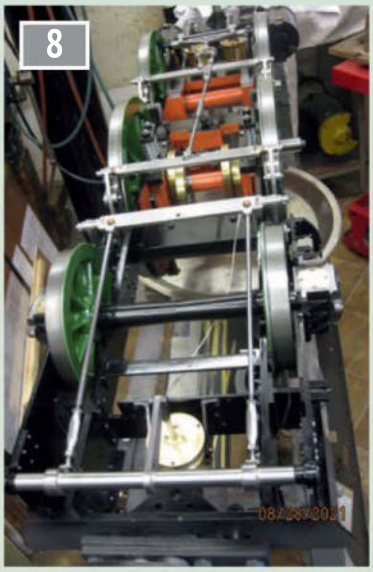
To release the brake, the drivers brake valve handle is moved away from the driver. The release is not instantaneous as is the case with a motor car but takes a few seconds while the train pipe vacuum is re-created.

On level track or slight down grades, a light application, say to 16 inches Hg, should check the train speed. A service application may be assumed at around 10 inches Hg. An emergency brake application is when the drivers brake valve is set to 'ON' and the train pipe vacuum is dropped instantaneously to 0 inches Hg. In this position, the ejector is by-passed and does not pull on the train pipe. Emergency braking should be avoided whenever possible to minimise damage (wheel flats) and

7

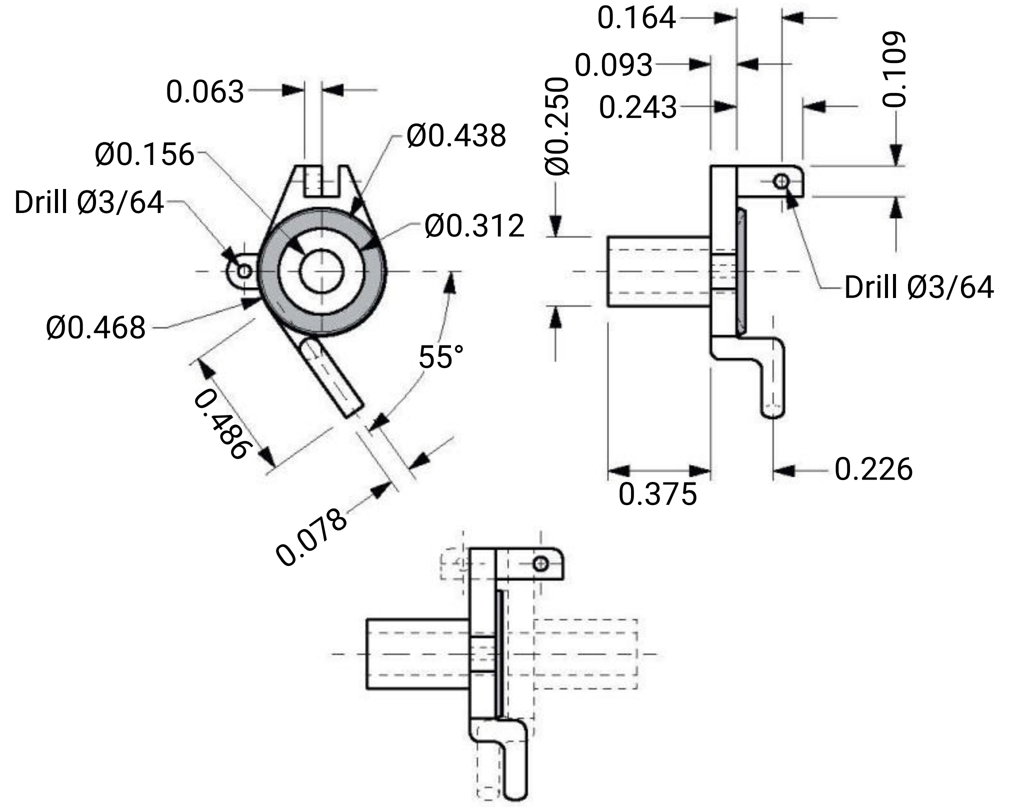


8



Brake system on the author's ⅛th scale Atlantic locomotive.

Fig 19



Proposal for 'standard' vacuum brake couplings.

premature wear of the system. It should be remembered that if wheels lock up, the train merely slides and no brake effort is obtained.

When braking to a stand, always begin to release the brake before stopping. This is to reduce straining of the brake linkage and bring the train to a gentle stop.

When stopped at signals for prolonged periods or in stations, it is normal to shut off the ejector and fully apply the brake. The driver's brake valve is then re-set to the 'OFF' position. Before setting off, open the ejector and re-create vacuum.

CAUTION! It is not advisable to fully apply the hand brake when the power brake is ON. If the hand brake is screwed hard on in this condition, damage may result to the hand brake linkage when the power brake is released.

In the case of stopping the train and detaching the locomotive or in emergency conditions when it is necessary to release the brake, first shut the ejector, then move the brake valve to 'ON'. The vacuum release valve is then operated to vent the locomotive and tender vacuum reservoirs. This will release the vacuum brake on the engine and tender. When set on a turntable, always apply the power brake and when parking the locomotive, always ensure the hand brake is applied.

At the end of a run after the boiler has been secured, disconnect the engine to tender flexible train pipe. Set the drivers brake valve to mid position, depress the vacuum release valve and allow any condensate to drain. Re-connect the pipe. Before the boiler starts to cool down, crack open all the valves to avoid contraction stresses on the valves and their seats.

Standardisation

In any engineering venture, an important consideration is standardisation and interchangeability. There are many diverse designs, some better and some worse, of passenger carrying cars that are used on small and miniature railways. Given this, it would be impractical to impose a retro standard for these vehicles and even for a brake system the variables involved would make it impossible to specify a standard for systems and their components that comprise them. However, a standard means of coupling brake hoses between vehicles should be considered such that any visiting locomotive can be coupled to a club's rolling stock. For preference, the full-size type of vacuum or air brake couplings form very effective seals and allow the couplings to part and vent the brake system in the event of a train division. A design for 7¼ inch gauge is offered in **fig 19**. Working scale size items can be obtained from our suppliers.

Conclusion

It is a fact that continuous power braking of passenger trains on British railways only came about as a result of several serious accidents, notably the Armagh disaster in 1889 when a runaway due to a train division killed 80 and injured 260. In the wake of this, parliamentary legislation was enacted which forced the railways to fit continuous and automatic brakes on all vehicles of passenger trains. That this state of affairs went unchecked until the late 19th Century must be considered a slur on our railway tradition. Operating a small or miniature railway should be a very satisfying and pleasurable experience. Braking of our trains must be enshrined as a prime requirement no different than for the full-size railway.

ME

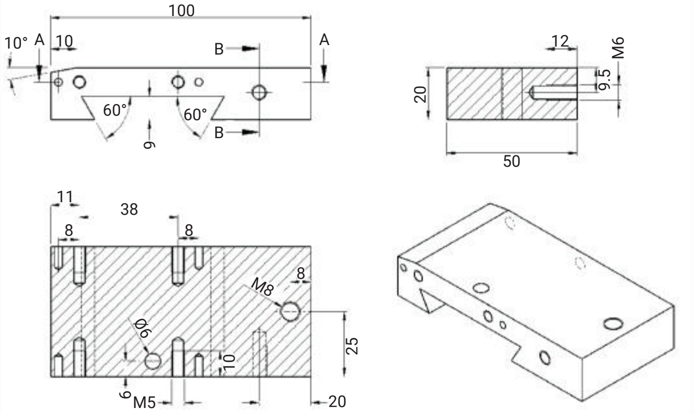
PART 3

Slotting on the Lathe

Jacques Maurel makes a slotting tool for his lathe.

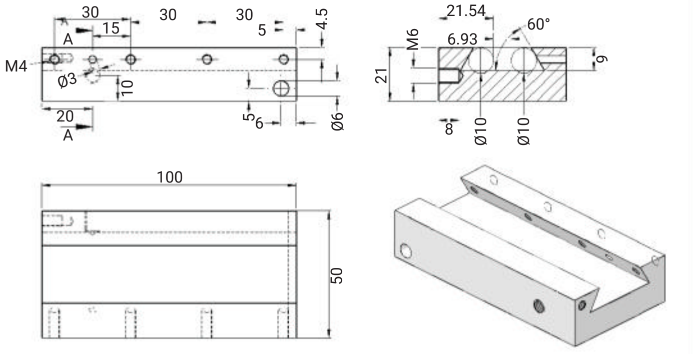
Continued from p.697, M.E.4717, May 19

Fig 20


100
10° A 10
B
A
60°
60°
6
B
12
M6
20
9.5
50
11
38
8
8
M8
8
Ø6
25
10
6
M5
20

Bracket A1

Fig 21


30
30
30
15
A
5
4.5
M4
Ø3
10
20
A
5
6
Ø6
21.54
6.93
60°
M6
21
6
8
Ø10
Ø10
100
50

Guide A2

Machining the attachment

The parts list is shown in **table 2** and parts are illustrated in **figs 20** to **38**. Here are some notes on machining some of the parts.

Bracket

(See fig 20, part **A1**)

The rear part must suit your toolholder.

Guide

(See fig 21, part **A2**)

The dovetail is checked with WPPins ('with plate pins', as described in *Model Engineer* issue 4588, June 2018, see **photo 9**).

Slider

(See figs 22 and 23, part **A3**)

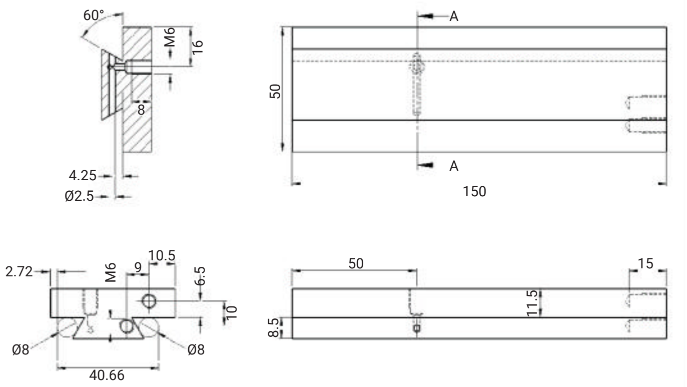
The parts **A** and **B** are welded together (see fig 19, Part 2, M.E.4717, May 19) and then annealed by heating in the fireplace overnight. All of the machining is done after welding except the groove in part **A3B**. The 2.5mm diameter oiling hole must be drilled before dovetail machining. Rub the sliding surfaces lightly with 250 grit paper after milling.

Driving fork

(Part **A4**)

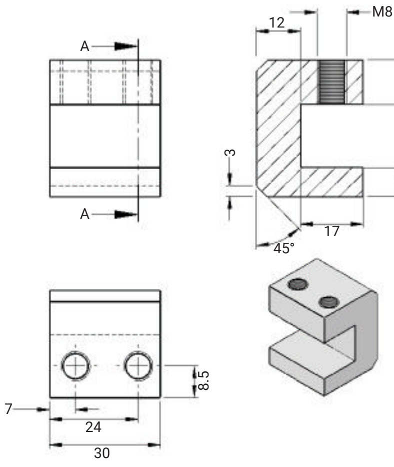
The same as part **27** previously described in fig 18 (Part 2, M.E.4717, May 19).

Fig 22


60°
M6
16
8
4.25
Ø2.5
A
50
A
150
2.72
M6
9
10.5
6.5
10
Ø8
Ø8
40.66
50
15
8.5
11.5

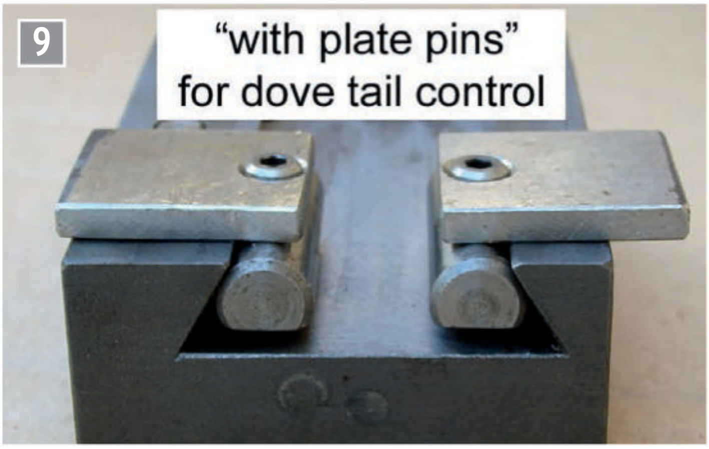
Slider A3 Part A

Fig 23


A
A
12
M8
12
17
3
8
17
45°
8.5
7
24
30

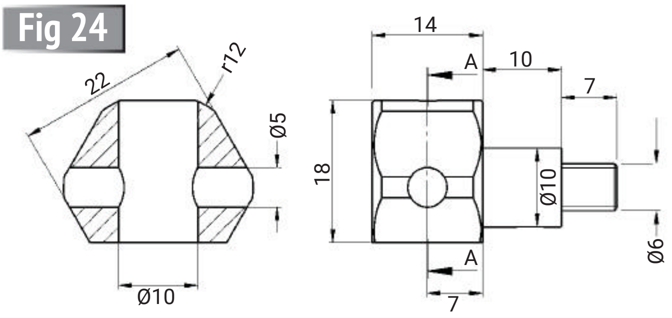
Slider A3 Part B

9


"with plate pins"
for dove tail control

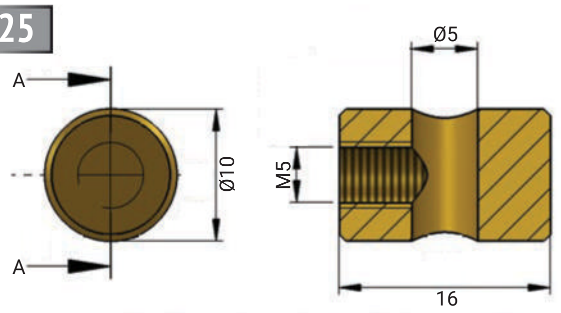
Checking a dovetail.

Fig 24


22
r12
Ø5
Ø10
14
A
10
7
18
Ø10
A
7
Ø6

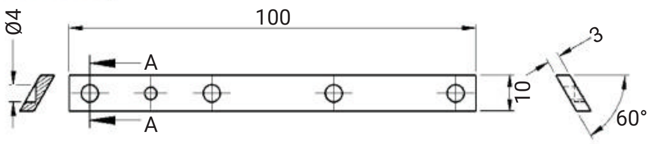
Friction Brake Body A27

Fig 25


A
A
Ø10
Ø5
M5
16

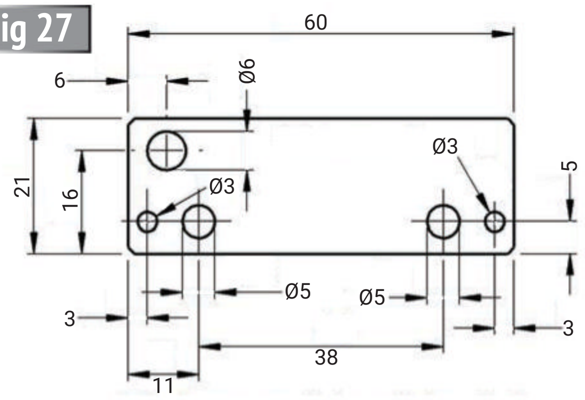
Friction Brake Slider A29

Fig 26


Ø4
100
A
A
10
3
60°

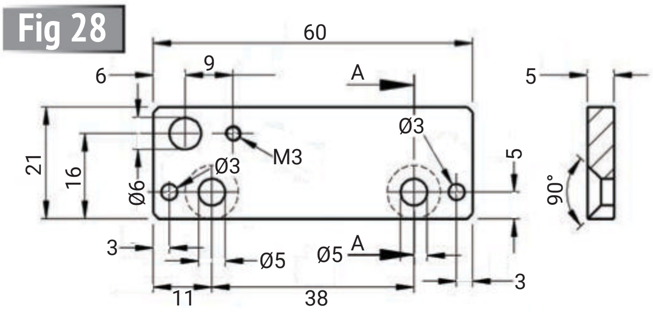
Gib A45

Fig 27


60
6
Ø6
Ø3
Ø3
21
16
5
Ø5
Ø5
3
3
38
11

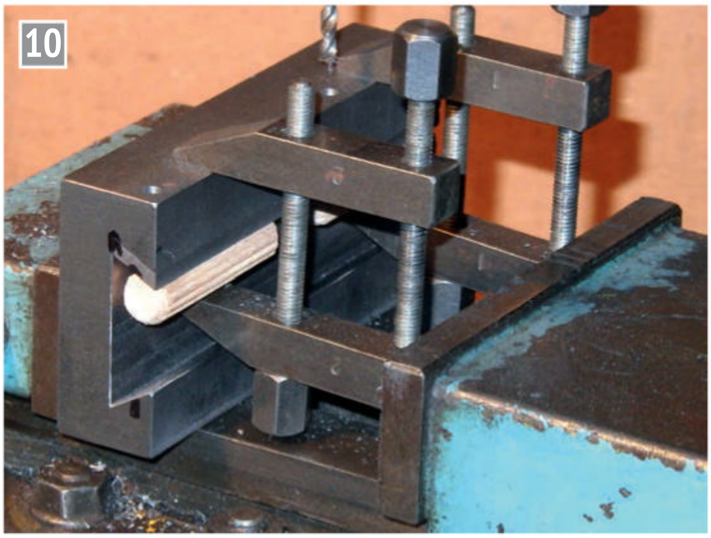
Higher Guide Side A5
Thickness 5mm

Fig 28


60
9
6
A
5
Ø3
21
16
Ø6
Ø3
M3
5
90°
3
Ø5
Ø5
A
11
38
3

Lower Guide Side A11

10



Clamping the gib strip for drilling.

Guide axle

(Part **A8**)

The slot for the locking plate is cut using a hacksaw, with two blades set side by side in the frame.

Relieving pad axle

(Part **A25**)

Machined from a standard socket screw to suit the bore of the pad **A24**.

Parts A27 and A29

(See figs 24 and 25)

The 5mm diameter hole must be drilled after assembly.

Brake spring

(Part **A30**)

External diameter 11, thread diameter 1.8, 7 loops, free length 38.

Spring loading stud

(Part **A32**)

A M5 thread 5mm long is machined at one end.

Gib

(See fig 26, part **A45**)

Look at **photo 10** to see how to lock the gib in the guide for machining the pin hole and the set screws bearing flats.

Setting the attachment

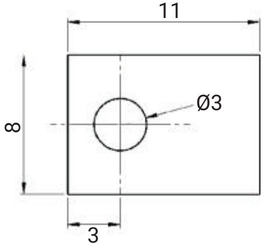
Don't forget to put some grease between all the moving parts.

Dovetail play adjustment

Adjust for no play and a slight drag; a locking washer **A21** is set under the nut **A19**; tighten each nut to flatten this washer, maintain the nut with a spanner while turning the screw for play adjustment and no more as the screw is maintained in back contact by the washer springiness. Thus you avoid the plague of the usual play adjustment (with no locking washer) as, when the play is correct, you must

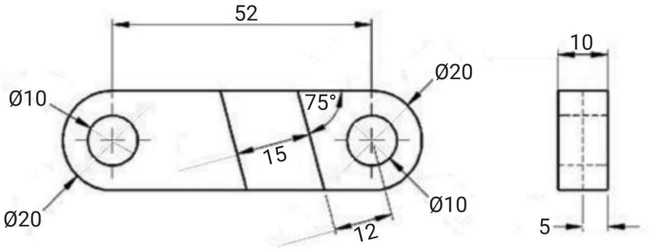
≫

Fig 29



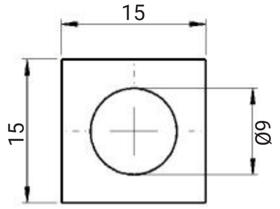
Locking Plate A13
Thickness 1.5mm

Fig 30


52
10
Ø20
Ø10
75°
15
Ø20
Ø10
12
5

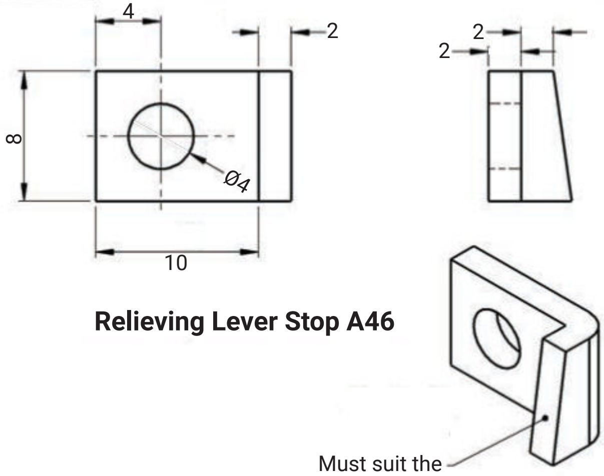
Relieving Lever A22

Fig 31



Relieving Pad A24
Thickness 5

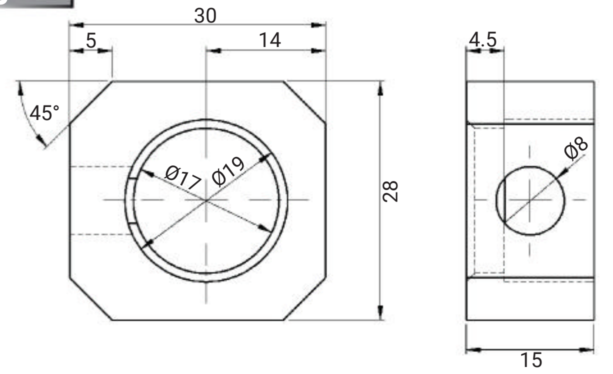
Fig 32



Relieving Lever Stop A46

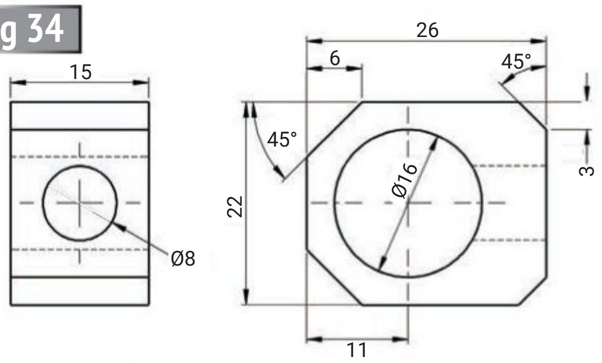
Must suit the lever angle

Fig 33


30
5
14
4.5
45°
Ø17
Ø19
Ø8
28
15

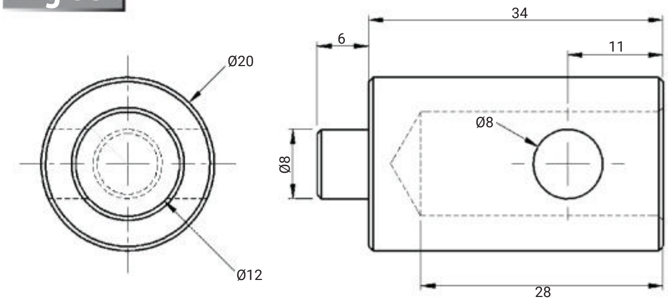
Spherical Joint Holder A42

Fig 34


15
26
6
45°
45°
Ø16
22
3
Ø8
11

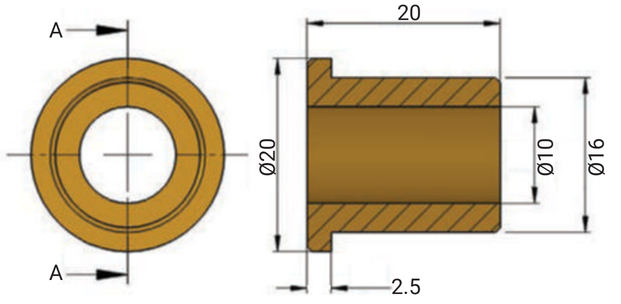
Bushing Holder A38

Fig 35


Ø20
Ø12
34
6
11
Ø8
Ø8
28

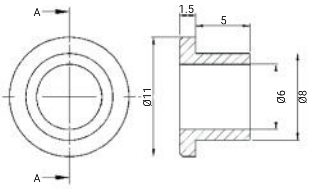
Variable Rod Right Part A41

Fig 36


A
A
20
Ø20
Ø10
Ø16
2.5

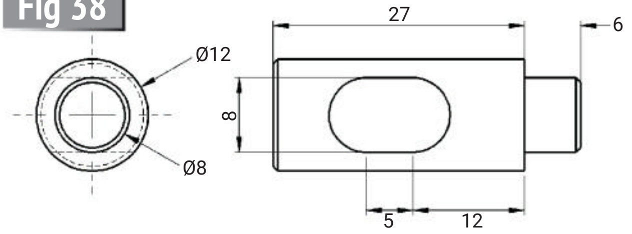
Bushing A36

Fig 37


A
A
1.5
5
Ø11
Ø6
Ø8

Brake Spring Guide A32

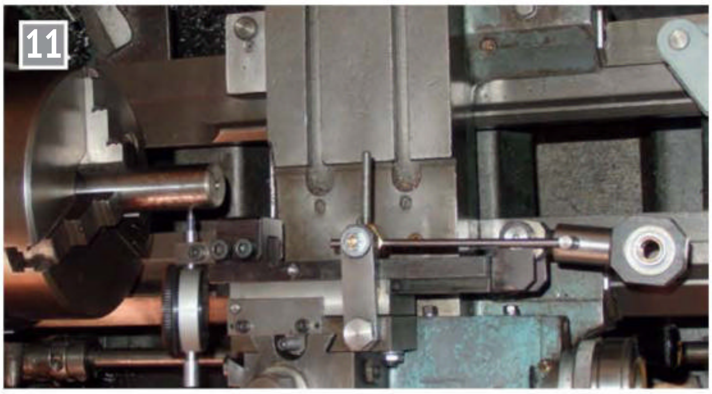
Fig 38


27
6
Ø12
8
Ø8
5
12

Variable Rod Left Part A40

Ref	No Off	Name	Material	Remarks
A1	1	Bracket	FCMS	
A2	1	Guide	Grey iron	
A3	1	Slider	MS	
A4	1	Driving fork	MS	
A5	1	Higher guide side	FCMS	
A6	2	Screw CHc M5-15	8 - 8	
A7	2	Pin		3mm diameter, 10mm long
A8	1	Guide axle	Silver steel	Diam 6, 64mm long
A9	2	Screw CHc M8-25	8 - 8	
A10	1	Oiler		Diameter M6
A11	1	Lower guide side	FCMS	
A12	2	Screw FHc M5-15	8 - 8	
A13	1	Locking plate	MS	1.5mm thick
A14	1	Screw CHc M3-6	8 - 8	
A15	1	Screw Hc M8-30	8 - 8	
A16	1	M8 nut	8	
A17	1	Locking washer		8mm diameter
A18	1	Pin		3mm diameter, 15mm long
A19	4	M4 nut	8	
A20	4	Screw CHc M4-20	8 - 8	
A21	4	Locking washer		4mm diameter
A22	1	Relieving lever	FCMS	
A23	1	Relieving lever axle	FCMS	
A24	1	Relieving pad	Bronze	
A25	1	Relieving pad axle	8 - 8	See text
A26	1	Nut M6	8	
A27	1	Friction brake body	Bronze	Hex 22mm AF
A28	1	Washer		8mm diameter
A29	1	Friction brake slider	Bronze	
A30	1	Brake spring		See text
A31	2	Brake spring guide	FCMS	
A32	1	Spring loading stud	8 - 8	Diam M6, 50mm long
A33	1	M6 nut	8	
A34	1	Friction rod	Silver steel	Diam 5, 140mm long
A35	1	Stove screw M6-12	MS	
A36	1	Bushing	Bronze	
A37	1	Driving axle	Silver steel	
A38	1	Bushing holder	FCMS	
A39	1	Friction rod driver	Silver steel	Diam 8, 45mm long
A40	1	Variable rod left part	Steel	0.5% carbon
A41	1	Variable rod right part	Steel	0.5% carbon
A42	1	Spherical joint holder	FCMS	
A43	1	Spherical joint		
A44	2	Screw CHc M6-15	8 - 8	
A45	1	Gib	Grey iron	
A46	1	Relieving lever stop	MS	2mm sheet iron
A47	1	Screw CHc M4-10	8 - 8	

Parts list



Adjusting the sliding movement of the slotting tool.

tighten the nut for locking and that moves back the screw and the play is increased!

From time to time put some oil into the nipple **A10**.

Parallel sliding

You must adjust the relieving stop (parts **A15, A16, A17**) for the sliding movement to be parallel with the spindle axis. For this, zero the top slide and use a DTI set in place of the slotting tool (see **photo 11**) by moving it along a reference cylinder set in the three-jaw chuck. The slide is moved by hand, the braking spring being removed, and the relieving lever pushed on the left.

Variable length rod

(Parts **A36**, **A38** and **A40**)

These are stuck together with epoxy glue - same thing for parts **A41** and **A42**. The movement between **A39**/**A41** and **A40** must be free. Don't put any grease between parts **A34, A27, A29** for good friction.

Notes

* One of the screw **A44** headS must be chamfered and/or part **A38** filed as there is a slight interference there.

* With the tool machining the back of the bore, the radial force is exerted on the right side of the dovetail (perpendicular to the flat part, see the previous note about the shaper).

Using the attachment

Here is an example for machining a 5mm wide key slot.

* Set the slotting attachment on the toolpost.
* Set the right slotting tool on the slider end, with minimum protrusion.
* Adjust the tool height: for this set a 5mm diameter piece of silver steel in the chuck and 'zero' a DTI (set vertically). Check first the pin run out and set the highest point in a horizontal plane, for the best accuracy. Adjust now the attachment height to 'zero' the DTI on the highest part of the tool edge.
* The part to be machined must now be set in the chuck and the chuck locked in position.
* Move the saddle for the tool to be just at the beginning of the bore (with no protrusion of the slider out from its guide) and lock the saddle.
* Move the cross slide for the tool to be near the radial starting position.
* Set the driving system on the tailstock, adjust the fulcrum position for the connecting rod to be as in line as possible with the slider.
* Set on the axle to link the slider with the driving lever, set on the driving rod, adjust the tailstock position for the driving rod to be in the starting position and lock the tailstock.

You're ready for machining. Feed 0.05mm for each stroke and don't forget to 'take the spring' from time to time.

●To be continued.

NEXT TIME

We look at how to choose the appropriate slotting tool.

Radial Valve Gears Again

PART 2 – STEPHENSON’S (1)

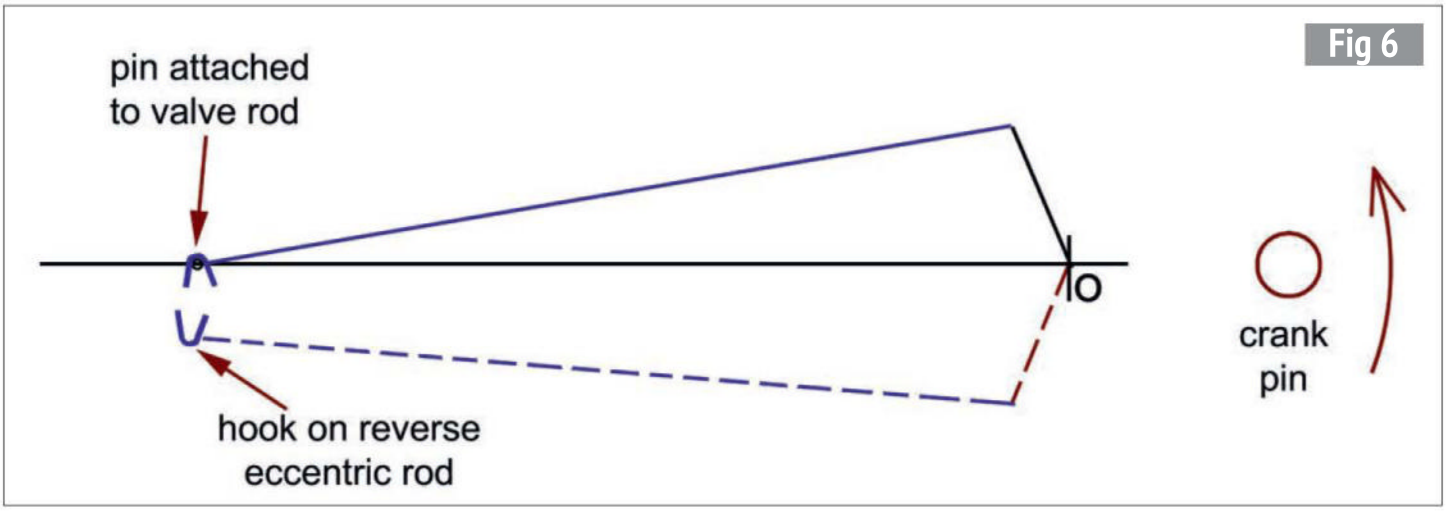


Fig 6
pin attached
to valve rod
O
crank
pin
hook on reverse
eccentric rod

Gab gear.

Duncan Webster sheds light on what is often seen as a complex subject.

Continued from p.744
M.E.4718 June 2

Reversible gear

How to make the engine go in reverse was shown in the first episode. Early locomotives had 2 eccentrics for each cylinder, and a means of unlatching the forward eccentric rod from the valve and latching the reverse, known as gab gear in the UK and V-hook motion in the USA (**fig 6**).

Stephenson’s Gear

In 1841, William Howe, an employee of Robert Stephenson, suggested that instead of the 2 gabs, the ends of the eccentric rods be connected by a curved slotted link. Whether he realised that this would give the opportunity to vary the cut off as well as the direction is not clear, it may well have been one of those serendipity moments. This is shown in **fig 7**. Now it starts to get a little confusing. Diagram ‘a’ (fig 7) shows what I will call from now on Open Rods Centre (ORC). If using outside admission valves, the crankpin is at 3 o’clock, if inside

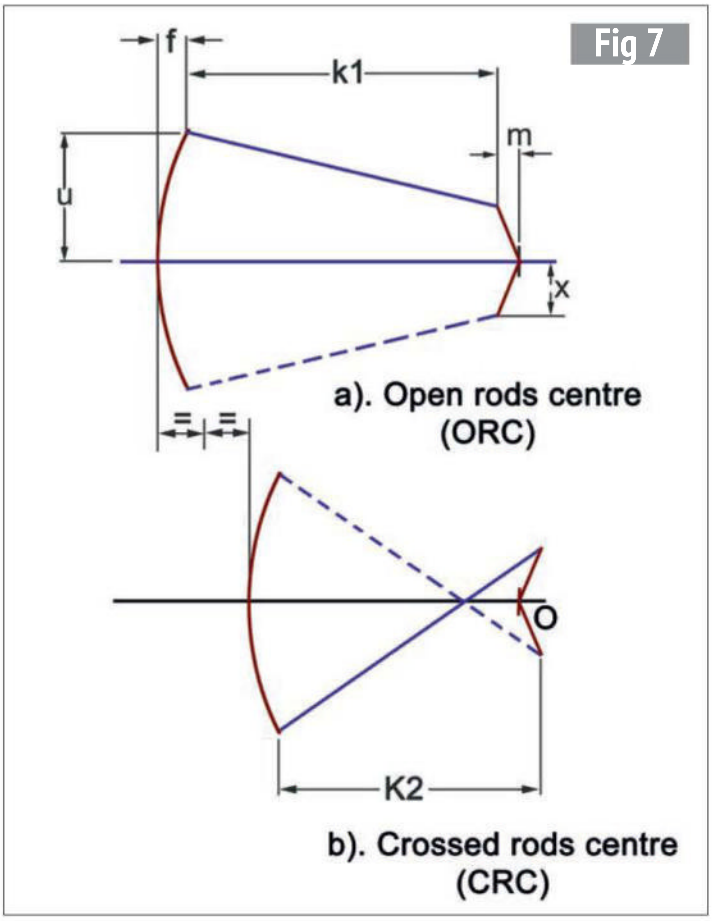


Fig 7
f
k1
m
u
x
a). Open rods centre
(ORC)
=
=
O
K2
b). Crossed rods centre
(CRC)

Crossed rods.

admission it is at 9 o'clock. Diagram 'b' shows Crossed Rods Centre (CRC), crankpin at 9 o'clock for outside admission, 3 o'clock for inside admission.

For many years I have regarded the booklet by Don Ashton (Stephenson's Valve Gear for Model Engineers) as the holy grail as far as Stephenson's gear is concerned. Trouble is I never understood it, largely because he produces various formulae like rabbits out of a hat without derivation. I've now devoted some time to trying to get to grips with it and I now think that the reason I don't understand it is that it has some approximations and is in one case not quite right. Not by very much, but to my pedantic mind little things matter! I think much of Don's work is based on an article in SMEE Journal 1975 by H.S. Gowan and this article can be downloaded from Don's website donashton.co.uk (**ref 10**). Note, my copy of Don's work is the 1976 booklet but it has since been re-published by Camden (**ref 11**). Throughout this analysis I am talking about outside admission valves. For inside admission, the crankpin is rotated 180 degrees relative to the eccentrics.

In Appendix III, Design 2, Don gives the design of a launch link gear (for explanation of launch and loco links see later), where he sets out:

lead in full gear = -0.014" (negative)
lap = 0.145"
max cut off = 79%

He then says that *v*, the valve travel, is calculated to be 0.610 inch. I make it *v* = 0.6023 inch. Don was close but no coconut. Will this make any difference to a real valve gear? I doubt it but it might as well be correct. Gowan gives a graphical method of arriving at *v*, which gives a third answer, 0.618 inch.

Having determined the valve travel, and using the equations from part 1 we can determine:

r = 0.3011 inch,
m = 0.131 inch,
x = 0.2711.

The dimensions m, x and r were defined in part 1. From now on I will use these dimensions.

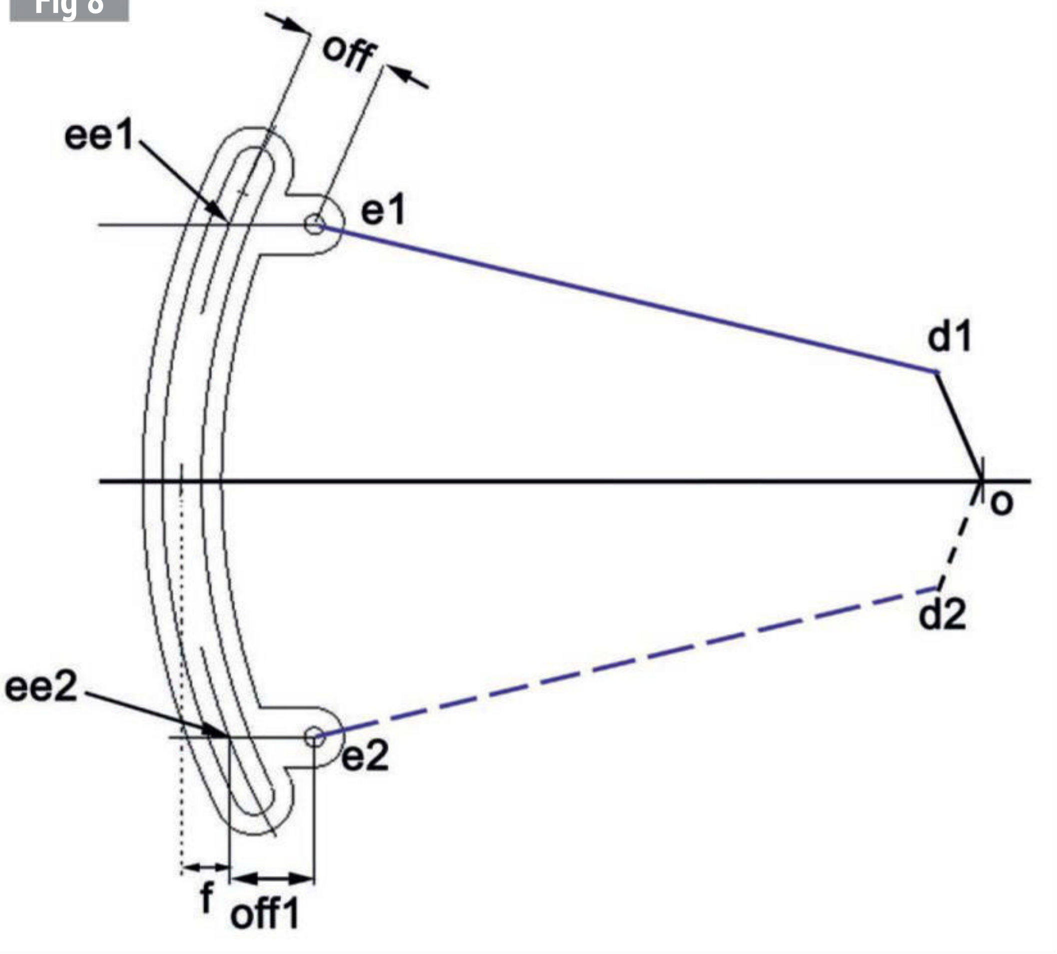
Don then recommends that the swing of the slotted link should be kept below 50 degrees to avoid difficulty moving the link whilst altering cutoff and the maximum distance from die to centre of curved link *u* (the *depth in gear*) should be 2.36 * x. This is derived from 1/sin(25) = 2.36. I have no reason to disagree with this.

Launch Links

If you have been following so far, you might have spotted the problem in the foregoing. It is assumed that in full gear the die is in line with the eccentric rod. It is possible to achieve this - some marine engines do so - but the resulting arrangement is very wide and will probably not fit within the confines of a locomotive. One solution is to have lugs coming backwards from the slotted link for the eccentric rods connections as shown schematically and not very convincingly in **fig 8**.

This was widely used in steam launches, hence the name, and by the GWR in its standard two cylinder locomotives. In Don's example, the slot radius is 4.312 inches, the radial offset *off* is 0.437 inch, and so the eccentric rod length is 3.875 inches. The dimensions of the equivalent eccentric above can be used directly but we will see shortly that this isn't quite the end of the story. I have shown the eccentric rod pins *e1, e2* as being horizontally offset from the slot radius by *off1*. This makes the computer sums easier, as in full gear the depth in gear *u = c,* the distance from centreline to pin. I've also named the pins, which will make life easier.

Fig 8



Launch links schematic.

Increase in lead at mid gear - launch links

Figure 7 shows a gear with ridiculously short eccentric rods (and no offsets, don't need that yet) to emphasise the effect.

Note how the crossing of the rods between ORC and CRC affects the lap + lead (inphase) motion. We can calculate the various die block positions from:

$$k1=\sqrt{(l^2-(c-x)^2)}$$

$$k2=\sqrt{(l^2-(c+x)^2)}$$

$$midGearTravel = 2*m+(k1-k2)$$

The lead changes from full gear to mid gear by:

$$\Delta lead=\frac{k1-k2}{2}$$

Using my figures for m, x, c:
m = 0.131 inch
x = 0.2712 inch
c = 0.6399 inch
l = 3.875 inches

≫

we get:
k1 = 3.8574 inches
k2 = 3.7664 inches
Δlead = 0.0455 inch

The mid gear lead = 0.0455 - 0.014 = 0.0315 inch which I think is a lot for a five-inch gauge locomotive.

The above formulae are not too taxing, but Don uses a simpler one, without explaining where it comes from:

$$\Delta lead = \frac{c * x}{l}$$

He gets away with this because if you expand the expressions for k1 and k2 using the binomial theorem and ignore the second order and above terms you get Don's version, so his is an approximation and as long as $c*x/l$ is substantially less than 1 it is pretty good. Unfortunately, he then goes on to use the slot radius as *l*, which I think is wrong. After all, it is the eccentric rods themselves which cause the phenomenon and the offsets contribute little or nothing. Using my figures in Don's equation gives *Δlead* = 0.0448 inch. At least having followed my explanation you will understand where it came from.

Equal Leads, launch links

It is desirable that lead is the same both ends of the cylinder in all settings of the valve gear (as before the magnitude of lead changes with cut off).

If we set the leads equal at mid gear the mean distance from the die block to the axle is:

$$k = \frac{k1 + k2}{2} + f + off1$$

where *f* is the distance from the chord between *ee1* and *ee2* to the arc of link radius 4.312 inches (see fig 7):

$$f = r - \sqrt{(r^2 - c^2)}$$

In this case k = 3.8119 inches, f = 0.0477 inch, *off1* = 0.4425 inch and this mean distance is 4.3021 inches.

Don then has a method of establishing the mean distance in full gear as follows.

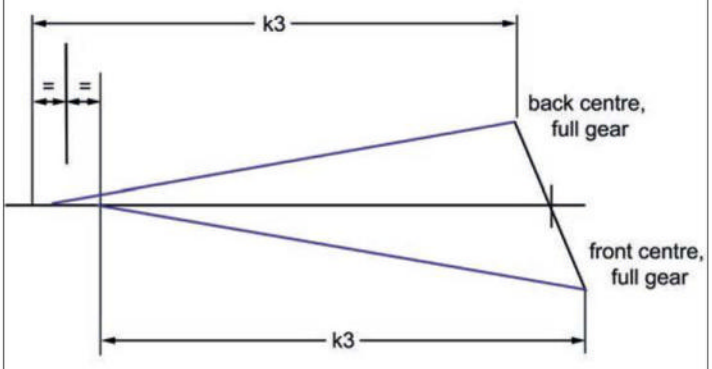
Figure 9 has a launch link gear in full gear, top half back centre, bottom half front centre. To make this work we have to assume that the offset and the eccentric rod are in line in full gear and so we use the link radius *r* instead of the eccentric rod length *l*.

The mean distance from the die block to the axle is:

$$k3 = \sqrt{(r^2 - x^2)}$$

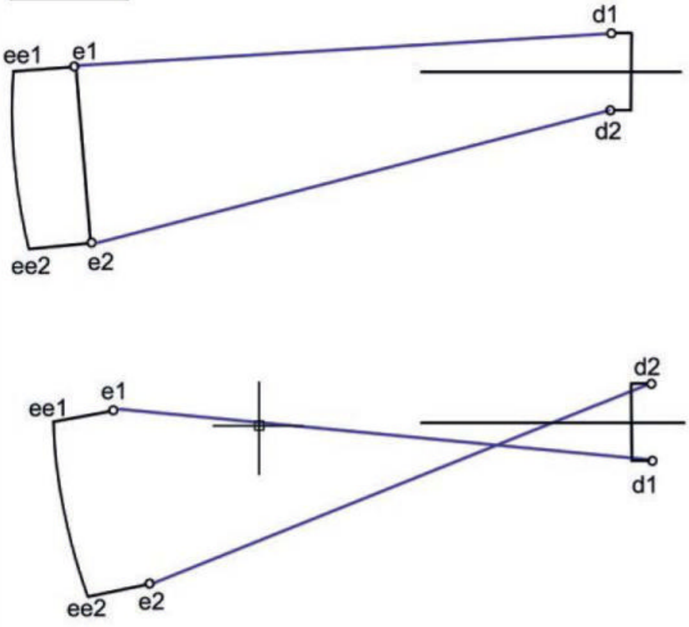
which comes out at 4.3035 inches, so the error is 0.0014 inch. This would not cause me to lose any sleep when compared with a full gear lead of -0.014 inch. It is in any case incorrect, so the assumption that the radial offset and the eccentric rod are in line is false. **Figure 10** has been drawn by calculating the real pin positions and then drawing the diagram to scale. It is not possible to just set to and draw the linkage without using a template (cardboard and pins!) or considerable trial and error. A short computer routine does this trial and error for you until the error is vanishingly small. Note that *ee1* is on the centre line, *e1* is above.

Fig 9



Full gear - launch links.

Fig 10



Launch links full gear (accurate).

The distance from *d1* to *ee1* in the crossed rods case, which should be 4.312 inches, is 4.300 inches - this error is bigger than the lead change. The actual change in mean position according the computer is 0.0009 inch, which is definitely not worth getting worked up about.

Don does suggest that we should slightly change the length of the eccentric rods so that k = k3.

On page 9 of his little book Don gives an equation:

$$l = t + \frac{x^2}{2 * t}$$

where t is the link radius. I think this is a pretty good approximation (binomial again) to:

$$l = \sqrt{(t^2 + x^2)}$$

which suggests that Don was trying to get the mean distance from the die to the axle in full gear to be equal to the (link-offset) radius but I do not agree that this is the correct approach.

I think that is enough for this episode - next time we will explore locomotive links.

●To be continued.

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Ref 11. Ashton D.L. (2007) *Design Procedures for Walschaert's and Stephenson's Valve Gears*. Available from the publishers listed on DA's website.

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Beer Heights Light Railway Signalling

PART 3 – POINTS

Mike Hanscomb, Hon Signal Engineer, BHLR, explains the workings of the signalling system at Pecorama.

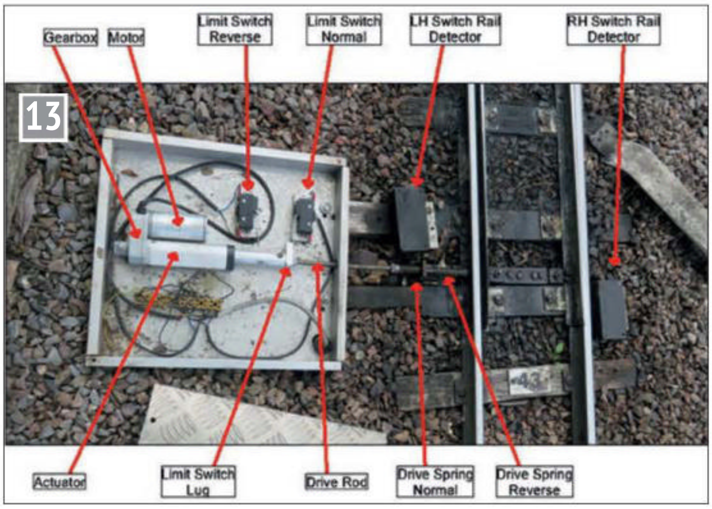
Continued from p.766, M.E.4718 June 2

The BHLR has seven motor points and ten spring points.

The point motors (**photo 13**) are mini-linear actuators type JS-TGZ-U1, 12-24V, 1 amp off load. The maximum current is 3 amps. They have 50mm throw and exert a force of 750N (168 lb).

Each point motor is fed from a 24V DC supply. As the motors can work on 12 to 24 volts, this gives a wide range of distances at which they can work from the power supply.

The actuator has internal limit switches, limiting its throw to 2 inches. The point throw is about 1 inch and, as the drive is via compression springs, a 1½ inch drive-rod throw is sufficient, so external limit switches are provided.


13
Gearbox
Motor
Limit Switch Reverse
Limit Switch Normal
LH Switch Rail Detector
RH Switch Rail Detector
Actuator
Limit Switch Lug
Drive Rod
Drive Spring Normal
Drive Spring Reverse

Beer Heights point actuator.

The drive springs are not fully closed when compressed. Therefore, motor points can be trailed through without damage, for instance during engineers' possessions.

●To be continued.

NEXT ISSUE

Calculators

Henk-Jan de Ruiter looks back to the days when pocket calculators were a novelty.

Bridgend

We visit the Bridgend and District MES at their track in Aberkenfig.

Noise and Vibration

Rhys Owen examines a phenomenon crucial to the operation – or failure -of many machines and explains how the subject is understood.

Generators

Bob Hayter looks at the development of electrical generators and the steam engines designed to drive them.

Valve Gear

Duncan Webster continues his analysis of Stephenson's valve gear.

Content may be subject to change.

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The Stationary Steam Engine

PART 47 – THE FIRST IRON BEAMS
The Ascendancy of the Elliptical Beam

Ron Fitzgerald takes a look at the history and development of the stationary steam engine.

Continued from p.688, M.E. 4717, May 19

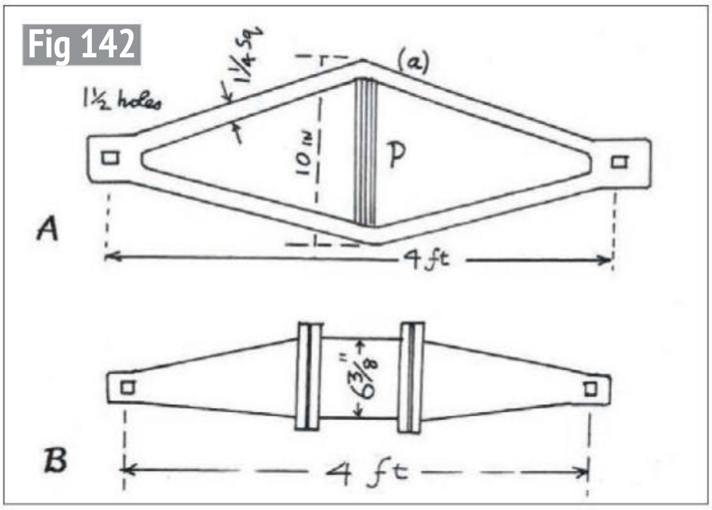
In accepting that the parabola was the optimum shape for a beam under load, John Banks acknowledged something that had been known since 1638 when Galileo published *The Two New Sciences*. Galileo's analysis had defined the bending moment resulting from a concentrated load applied to successive intervals along a simply supported beam as the product of multiplying the respective distances from each point of support. This could be expressed as a curve drawn within the section of the beam. Only the parts of the beam section below the curved line played a role in carrying the load, any material above being redundant. Galileo was also aware that the resistance to deflection of a rectangular section increased as the square of its depth and if the resisting moment was to be equal for each section, the successive section depths should increase according to a parabolic curve.

This rationalisation remained of little relevance as long as beams came directly from natural sources. Hacking timber and stone to conform to a hypothetically correct profile was not only unnecessary, it complicated the profile of the surface that was intended to support the floor load. The situation changed with cast iron. Beams could be cast to the theoretically correct shape as easily as they could to any other arbitrary form and the addition of a level flange provided a means of supporting the floor. Eliminating redundant material reduced costs and for the first time in history it was possible to have a structurally efficient load bearing beam that was economical to make. As far as the steam engine beam was concerned, the nature of the loading suggested parabolas for both the top and the underside of the beam. The curve that was ultimately adopted combined the parabola with its cousin the ellipse, the beam form that Banks illustrates in his figure 4, plate 3 in his book.

It is difficult to say whether the double-triangle, perforated-web beam was the precursor to the elliptical beam or whether it was seen as a contemporary alternative but very quickly the elliptical beam became the standard. How much this owed to Banks is an unresolved question. His influence may have been greater within his northern lecturing circuit and foundries in Bradford and Leeds. There is nothing to show that Boulton and Watt owed any obvious debt to Banks or to the Aydon and Elwell tests as they moved from timber beams to cast iron. It is more likely their knowledge drew upon sources that were more immediately local to Birmingham. When, in February 1798, the drawing office produced the design for Homfray's plate beam with its near parabolic top edge, it was not conceived in isolation. At this time Boulton and Watt were closely associated with the Ditherington Flax Mill which was at least partially complete by September 1797 and for which William Hazeldine had cast the iron beams. It is improbable that Bage and Hazeldine did not carry out tests prior to manufacturing the ironwork for the mill and had these tests been carried out, Soho may well have been aware of them. Unfortunately, no evidence for such tests has survived. Professor Skempton could only refer Bage's tests which he assumed related to the Meadow Lane Mill, Leeds built five years later (**ref 239**). It must also be conceded that the extent to which the Ditherington beams observed the correct parabolic longitudinal profile is dubious.

The designs for the South Wales ironwork's blowing engine beams probably never progressed beyond the drawing board but towards the end of 1798 developments from a different direction re-focused attention on the load bearing beam. Thomas Barnes (1764-1801), the Boulton and Watt agent in the North East, was viewer for the Lawson Main Colliery on the north side of the Tyne. The pits were inland from the river and a wooden waggonway was laid to reach the shipping staithes. In the final quarter of 1798 an experiment had been undertaken with self-supporting cast-iron rails. Cast-iron bars laid on the top of wooden rails as wearing surfaces had been in use for many years

Fig 142



*The two beam specimens tested by the Soho Foundry (*The Transition from Timber to Cast Iron Working Beams*, James Andrew, Jeremy Stein, Jennifer Tann, Christine Macleod, T.N.S. Vol. 70, No. 2, 1998-1999).*

and in 1798 Aydon and Elwell had supplied several tons for the Lake Lock Railroad near Wakefield. These rails were continuously supported by the timber rails beneath them and were thus not directly load bearing. It was almost certainly Barnes who conceived the idea of using a T-section cast-iron rail with the T-head of the rail forming the running surface and the web supported at its ends only by stone cross sleepers. The rails were capable of taking the load of the 4-ton waggons because the deep web gave the rail resistance to bending stresses.

Barnes seems to have had the first experimental rails cast locally but when he decided to lay the rails more extensively he turned to Soho for the castings. Southern was sent a sample but felt that the web needed to be thicker and he offered to undertake some tests. In December 1798 he reported to Barnes. Two rails were cast, one from the air furnace and one from the cupola. The rails were three feet long with webs 5 inches deep and half an inch thick. The air furnace rail failed at 7 tons and the cupola rail at 5½ tons. Barnes had also carried out his own tests with the rails which were currently in use. These had webs 3/8ths of an inch thick. His test rig used a lever system that applied the load at mid-span and the results gave breaking loads of 5tons 16cwt, 6 tons 6cwt and 6 tons 17cwt. The web of the rail was not truly parabolic but increased in a triangular form to a maximum at mid-span.

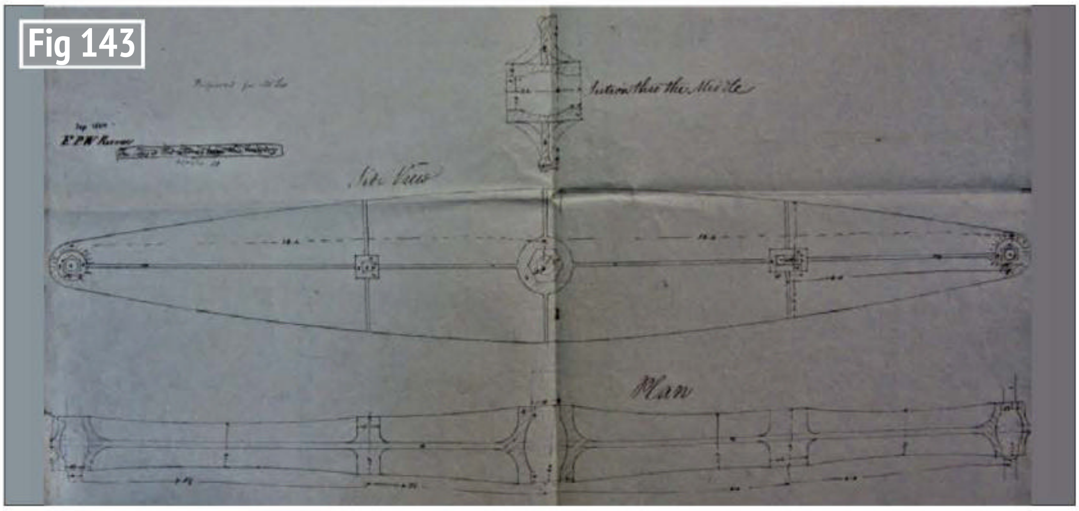
There is nothing to show that Boulton and Watt made any further progress in the direction of using cast-iron engine beams until the middle of 1800 when work began on designing the monster engine that was ordered for George Lee's Salford Twist Mill. Lee's mill has been previously referred to in connection with the evolution of the fireproof textile mill as the immediate successor to the Ditherington Flax Mill. It has been suggested that he wished to have an all-iron engine in order to complete the fireproof construction of his premises and that this was the main factor in prompting the choice of iron for the beam (**ref 240**). This is unconvincing and it is more probable that the enormous size of the engine for the period, 100 hp (100 hp was not attained again by a Boulton and Watt engine until 1838) from a 48 inch cylinder meant that a solid timber baulk of appropriate dimensions would have posed major problems. As trussing or laminated compound construction were equally impractical a wholly iron beam moved to first consideration.

Lee, a man with enthusiasm for innovation, may have worked with Southern to produce the first explorations. Between July and October 1800, two designs were worked up to model test stage (**ref 241**). The first model was a double triangle open-web beam of cast iron. The common base of the two triangles was a wrought iron prop (**fig 142**). With the beam resting on its lower external angle and one end restrained, a load was applied through a weighted lever at the other end. The beam failed at the upper vertex (marked *(a)* on the sketch) with an effective load of two tons at each end. Southern suggested that this represented failure at 4 tons per square inch of section although the point of fracture showed a casting defect. The second proposal involved a cast iron beam of three parts assembled around a centre tubular section. By means of flanged joints, cones were riveted to either end of the centre drum. The metal thickness was 0.375 inches and a gudgeon was cast onto the middle section which formed the fulcrum when the test load was applied. Using the lever press, failure took place at 65 cwt. but the iron was again flawed at the fracture.

Southern seemed to favour the tubular construction over the triangulated frame and computed that with a full size beam three feet in diameter at the centre and with 1¼ inch metal, failure would occur at 65 tons notwithstanding possible casting faults. Assuming a piston load of 18,000 lbs he estimated a maximum end load that the engine would subject the beam to was 10 tons giving a factor of safety of 6.5. However, he foresaw difficulties in casting and thought that it might cost up to £200. In his letter to Lee which described these tests (**ref 242**), written on the 15th October 1800, Southern also gives details of a further open web beam of parallel section which was assembled from separate pieces or alternatively a plate beam. Of the two he favoured the latter which he suggested would sustain 150 tons at each end.

Dated in the month previous to the above letter, there is a sketch drawing in the Boulton and Watt Archive that seems to represent the first design for a full-size plate beam to reach the stage of casting (**fig 143**). Written the back

Fig 143



The first design for the Salford Twist Mill 100 hp engine. FPW Reverse. Beam proposed for Mr. Lee. Dated Sept 1800. Reverse. (Boulton and Watt Archive. Birmingham Central Library.)

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of the drawing are the words *…..Beam proposed for Mr. Lee. Dated Sept 1800.* The longitudinal profile is elliptical with a web 2 inches thick and 24 feet 8 inches between outer centres. The mid-span depth is 4 feet and the web carries a longitudinal centre rib with vertical stiffeners at the centre and at the points where the parallel motion and the pump is to be suspended. Gudgeon and similar holes are bossed. The holes through the casting are barrel shaped, presumably to give a degree of rotational freedom to the gudgeon pin and the other attachments in order to compensate for settlement or other movement of the engine's frame. Although it is not shown on the elevation, the midspan cross-section drawing shows bulb shaped flanges attached to the rims of the parabolas. An estimate of the weight, calculated on the basis of the drawing suggests between 2¾ and 3 tons.

This beam design does not appear to have been the one used for the engine. A note, crossed through, is appended to the drawing… *copy of this* (drawing?) *returned from the foundry* … Underneath is a further comment in pencil … *Waste* ….possibly indicating that the casting was a waster, the description for casting that has proved unsuccessful following pouring. The foundry may have encountered difficulties in casting this beam for, in January 1801, a second design had been made for Lee's mill which was quite different (**fig 144**). This considerably reduced the metal masses by resorting to a paired beam design with spacers to maintain separation. It is almost certainly this beam that Southern refers to in his October letter to Lee and it is likely to have been the final form. Lee's engine evidently met with major problems and in 1803 a new 48 inch cylinder was fitted possibly along with more extensive rebuilding.

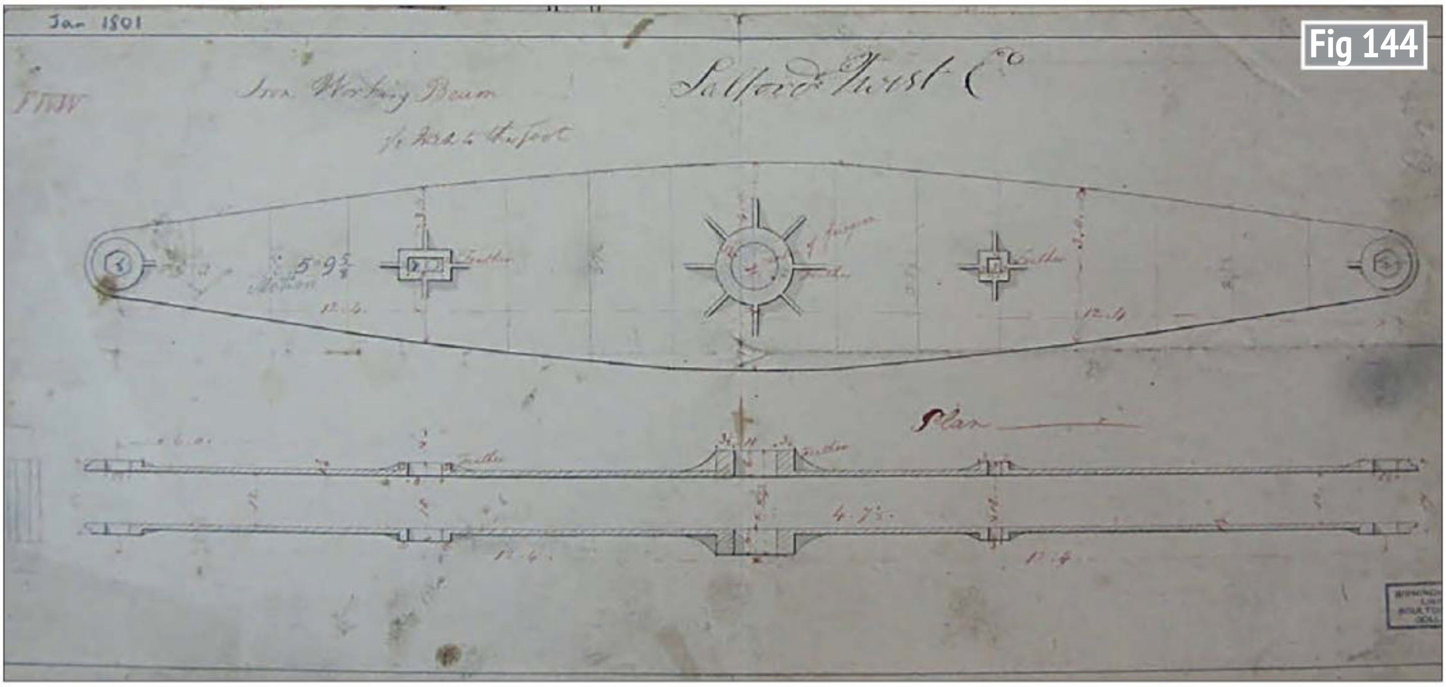
Throughout this period John Rennie continued to be closely associated with Boulton and Watt although he was increasing occupied by civil engineering matters. His eminence in this field has tended to overshadow his continuing involvement in mechanical engineering where his competence was equally recognised. Rennie's first engineering premises were located at Old Jamaica Wharf off Upper Ground Street, Lambeth, which acted as the base for the Albion Mills contract. His reputation as a millwright moved to the front rank after the Albion Mills was completed and much business ensued for Jamaica Wharf not only in corn mill work but also in other milling activities such as fulling and grinding mills, distilleries and breweries. These were the traditional trades of the millwright but in manufacturing the machinery for Boulton's Mint in 1786 and its reconstruction in 1798 Rennie extended his experience into more modern engineering. Metal rolling mills were part of the sequence of machines used for minting coins and this led to a diversification into sugar cane crushing plant which found a keen market in Jamaica.

Rennie seems to have arrived at an agreement with Boulton and Watt that they should cooperate in the sugar market business with a view to supplying the complete plant including power source. Accounts of how this relationship worked in practice are confused. Rennie seems to have designed the machinery and it is possible that the castings were made at the Soho Foundry before being despatched to Jamaica Wharf for assembly and shipping. What is not disputed is that Rennie came to an informal agreement not to enter into the business of building steam engines independently and this remained his position throughout the rest of his life.

It is not known whether Rennie was involved in the Jamaica sugar trade before the first joint venture with Boulton and Watt but in 1801, a 10 hp engine was sent out to Turnbull & Co. who were the successors to Paul Benfield of Berbice, Guiana. Benfield must have died recently as the drawing office worked to him as the named customer. Rennie argued for an iron beam for this engine as the climate threatened to make a wooden one unstable. The first drawing office draft for Benfield's beam is dated 15th December 1800 and in the same month the finished version of the drawing was completed (**fig 145**). An engine was despatched to Turnbull, Forbes & Co., (Paul Benfield) in Guiana although it may be that uncertainty arising from Benfield's death led to the original beam to this design being fitted to a 20 hp sun-and-planet machine, which was sent to the Manchester cotton spinners Taylor Weston and Co.

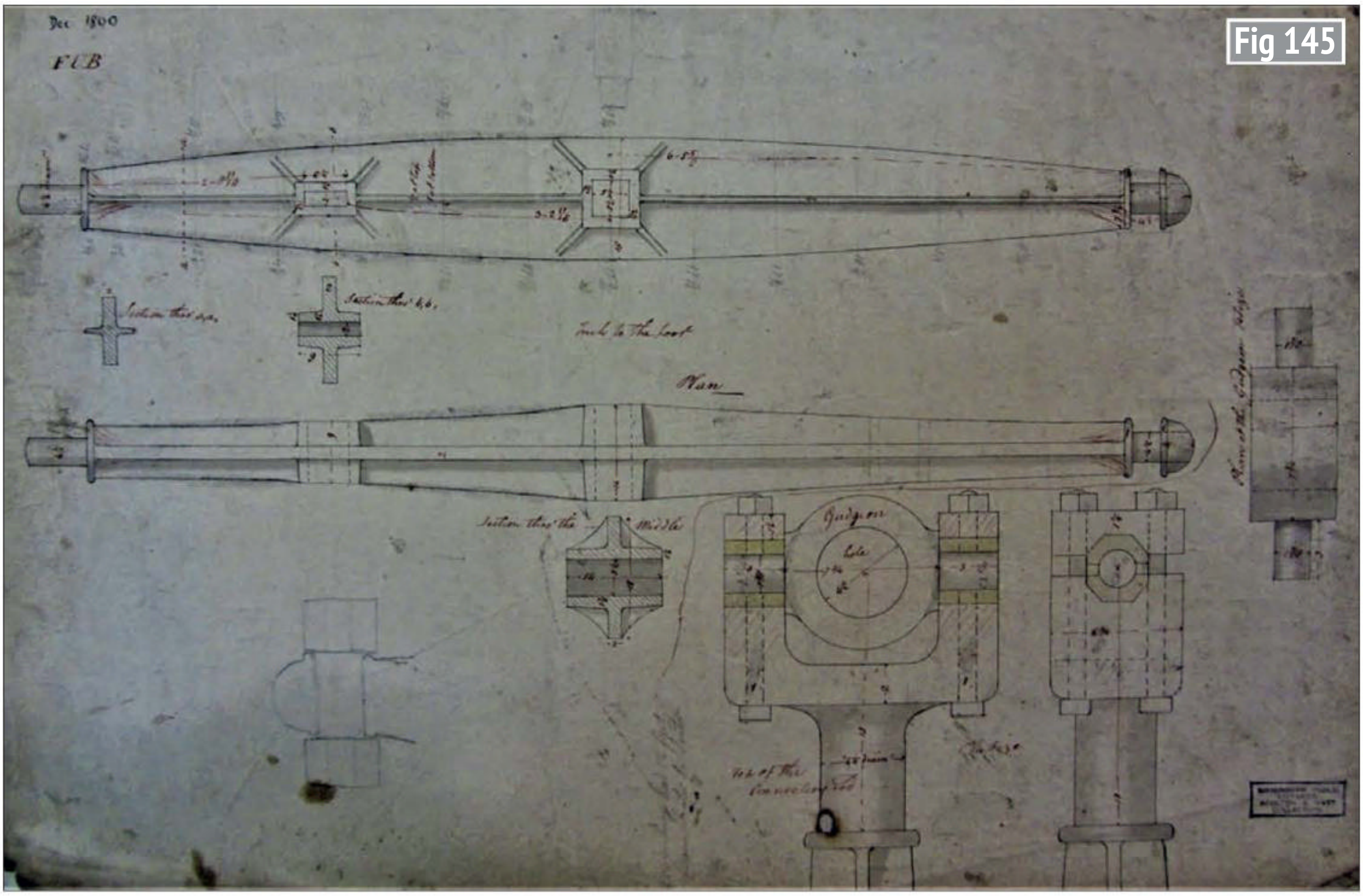
Both Benfield's and Taylor Weston's engines were considerably smaller than Lee's engine. The single plate beam is 14 feet long with a rib running along its longitudinal centreline. The main gudgeon is mounted in a square bossed hole as is the

Fig 144



The second design of beam for the Salford Twist Mill. Reverse: FWW Pencil note Jan. 1801. (Boulton and Watt Archive. Birmingham Central Library.)

Fig 145



FUB. Boulton and Watt Engine Catalogue says: Iron beam and top of connecting rod for P. Benfield (engine transferred to Taylor Weston & Co.) partially coloured drawing. Dec. 1800. (Boulton and Watt Archive. Birmingham Central Library.)

parallel motion back link anchor but the ends of the beam are turned journals with detachable caps. The connecting rod and the parallel motion to piston rod link terminate in a Y-yoke bearing that runs on the journal so that there are two degrees of freedom to accommodate misalignment.

Three months after the Jamaica engine left Soho, in May 1801, Rennie was appointed Engineer for the construction of the London Docks. As the excavation got under way it became necessary to clear the workings of water to which end he ordered a 28 hp engine along with a 20 hp to drive a mortar mill and an 8 hp machine to work a pile driver. All were delivered by the end of 1801. For these engines Rennie specified cast iron beams, which on the basis of a letter to Watt (**ref 243**) he argued his preference in terms of the difficulty in obtaining suitable timber beams. He had to reaffirm his request in December as Soho remained hesitant (**ref 244**).

Rennie was in a position to exert a direct influence on the design of the engines that he was involved with and his enthusiasm for cast-iron generally probably predisposed him towards the cast-iron beam but there may have been another significant factor in his confidence in the material. It will be recalled that he was one of only two London based subscribers to John Banks' *Treatise on Mills*, published in 1795. Whether he was personally acquainted with Banks is unknown at present but it is at least possible that there was continuing contact between the two men. From 1791, Rennie was frequently in the north in connection with the Rochdale Canal and the Lancaster Canal which terminated near Kendal. He was also a frequent visitor to Leeds where Benjamin Gott engaged him to design machinery for his new Bean Ing Mill. There was however another point of contact, Aydon and Elwell. The Shelf Foundry supplied cast iron plate rails to Rennie's London Dock project in late 1801. At the same time they may have supplied the cast-iron swing bridge for the Wapping entrance lock to the dock. There was certainly a continuing relationship subsequently between Rennie and Aydon in the design of both fixed span and swing bridges. It is no unrealistic supposition that Rennie knew of the Aydon and Elwell beam tests and it was through him that Boulton and Watt gained access to Banks' theory and his advocacy of the elliptical beam.

●To be continued.

NEXT TIME

We see how the design of the beam engine matured during the early 19th Century.

REFERENCES

239. *The Origin of Iron Beams,* A. W. Skempton, Actes du 8 Congrès International D'Histoire des Sciences, p. 217.

240. *The Transition from Timber to Cast Iron Working Beams,* James Andrew, Jeremy Stein, Jennifer Tann, Christine Macleod, T.N.S. Vol. 70, No. 2, 1998-1999.

241. Letter reproduced in *The Transition from Timber to Cast Iron Working Beams....Op. cit.* B & W Foundry Letter Book Volumes 68 and 71.

242. B. & W. Foundry Letterbook Volume 71.

243. Rennie to Watt Jnr. June 30th 1801.

244. Rennie to Boulton and Watt Dec. 28th 1801.

Why I Write (for *Model Engineer*)

Geoff Theasby confesses all.

Since my early teens I have written to some extent. It started as a part-time volunteer interest and, since I retired about 15 years ago, I have been able to do more. I always write non-fiction, I don't do fiction - in the words of Jonathan Frakes, 'they make it all up!'

Published work

My first printed item was for a Keighley Scout magazine and I was about 15. It was printed without being offered for corrections, proofreading, or similar, and I am ashamed to read it now. My first paid contribution was to the magazine *Practical Wireless* in February 1967, about setting up a workshop. I bought a short-wave receiver with the proceeds. Thus began my meteoric rise to inadequacy…

Over the next 55 years I was published in over 20 different periodicals, including the short-lived *Yorkshire on Sunday*, *Mensa Magazine*, *Ham Radio Today*, *Electronics Today International*, *Practical Electronics*, *Radio Communication* (from the Radio Society of Great Britain) and *Model Engineer*. Before I began my regular Club News column, I edited the Northern Heights Amateur Radio Society (Halifax) newsletter for several years. I also did electronic subcontract work for various local companies and tried selling my own amateur radio products, a venture which did not succeed. Later I edited a Mensa environmental newsletter (*Green Scene*) for 5 years, in fact writing most of it. On moving to Sheffield upon retirement I noticed that Hallam University was offering a short evening course in Journalism so I enrolled in that, all in the interests of helping with my writing. Previously, I had gained RSA Word Processing and Text Processing qualifications in Keighley College and Craven College, Skipton. I began writing regularly for *Model Engineer* magazine in 2010 and have appeared in it every fortnight since (barring holidays) - over 12 years and counting!

Editing Club News

How I was appointed to edit *Model Engineer's* Club News column was interesting, a good example of being suitably qualified, in the right place and at the right time. I saw an item in the editorial of one issue for someone to handle the reviewing of the magazine club newsletters and moved on. A month or so later the request was repeated in more detail, differently worded, and I thought 'I could do that'. When Deborah arrived home I showed her the item and she said "That's got your name all over it!" History draws a veil over the identity of my fellow contenders but I was invited to submit an example, using the club newsletters posted to me. I did so and was told to carry on… and so it continued to this very day. I am self-employed, freelance, have no contract of employment, can choose my own schedule within the publishing limits, and that's the way I like it.

Although I had written several items for the Mensa regional newsletter, one blinkered individual claimed at a regional meeting that he had never heard of me. Well, several thousand million Chinese have never heard of either of us, Sunshine!

Why do I enjoy writing for the *Model Engineer*? The correspondence with readers, the exhibitions, visiting club sites, learning new things and following the activities of model engineering clubs around the world.

How do I write? Basically, when the spirit moves me. Although a regular writer for *Model Engineer*, I have two weeks in which to write my column and how I do that is down to me alone, mostly by reviewing e-mailed club newsletters. Other items suggest themselves, often at inappropriate moments, so a notepad or similar smartphone 'app' by my bed is useful in case I wake up during the day.

Railways

My interest in railways began quite suddenly, after visiting the K&WVR on its opening weekend in 1968. I was never a 'trainspotter'. From there I progressed to physically helping to lay or replace track on that railway, including one time when I and two others were given the task of bending a length of rail, using a 'Jim Crow', centred on a chalk mark on the rail. We must have been over enthusiastic because the rail split right at the chalk mark! I maintain to this day that it was the foreman's fault for using too strong a piece of chalk…

Finding the big railway a bit of a challenge, physically (I couldn't lift a sleeper on my own, and likewise a Kango hammer), I found I could cope much better with narrow gauge track. I remember using one of the Stop/Go boards to direct traffic when unloading rail by the roadside. One lorry driver didn't stop until I could feel the heat of his radiator behind me. Possibly an opponent of the railway, or maybe he didn't like the English. Anyway, I studiously ignored him and I lived to tell the tale.

One who certainly did not like the English was a local who was part of the JCB team shifting ballast. One tea break I managed to use the 'wrong' mug and it was seized and the contents hurled through the doorway into the Welsh rain, or 'Liquid Sunshine' as it was known. Being a guest in his country, I apologised, and nothing further was said (in English anyway…).

On another occasion, I was labouring for the surveyor and managed to get a location peg in the wrong place. So, if you feel a slight tremor just after passing Glan y Pwll sidings, blame me. I took Deborah to Gogledd Cymru (North Wales) in later years and, whilst travelling on the Tal y Llyn railway, we were discussing non-contentious matters when Deborah was heard to refer to the Welsh Highland Railway as the 'real' railway, or some such phrase, and I suggested that it might be wise not to continue, as "that's fighting talk around here..." and the other occupants of the carriage concurred.

Amateur radio

My interest in radio arose when, after doing a paper round and caddying at the golf club, I bought myself a little transistor radio, a 'Kendy'. Soon afterwards, I heard a strange voice over the top of the BBC Home Service, it was a neighbour, G3SMB, whose signal, being so strong, overwhelmed the cheap radio. Thus began a lifelong interest in all things electronic. We remained in touch until he died. I will have held my callsign, G8BMI, for 50 years next October. This means I have passed a technical exam proving myself competent to operate a radio station without endangering others or causing interference (**photo 1**).

Influences

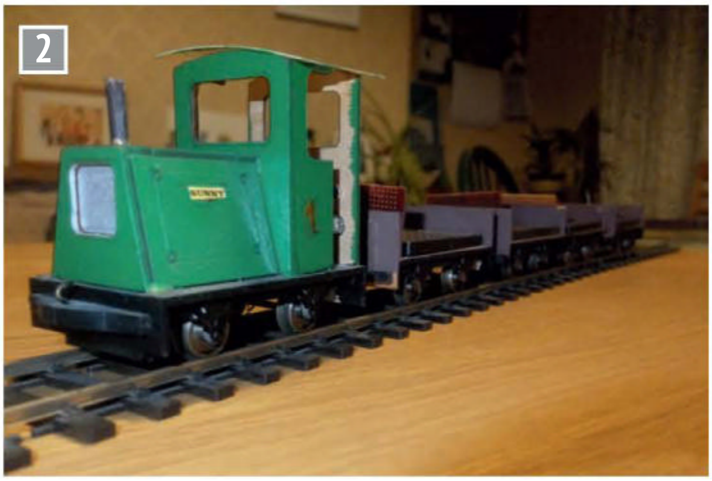
The Sky at Night; school physics lessons; the IGY/Telstar/Jodrell Bank/Sputnik, moon landings scene; having a car mechanic Dad, which meant that mechanical matters rubbed off on me, leaving an oily mark…; plus I had a great Christmas present one year, Meccano! For humour; ITMA, the Goon show, an unofficial, school, Fourth Form magazine entitled The 4A ('Foray') (I still have copies) and Radio 4's Beyond our Ken/Round the Horne, Monty Python.

I like to read – P.G. Wodehouse, Dorothy Parker, Douglas Adams, for the way they said it; Richard Feynman, for being a physicist and a 'character'. Otherwise, technical books, on most subjects, including one that gave me a 'different' pickup line: "I have an interesting book about radar". Well, it worked with Deborah, now my wife of 17 years! My heroes are, in science, Sir Bernard Lovell, instigator of the famous Jodrell Band radio telescope, and in humour, Max Wall and Emo Phillips.

1

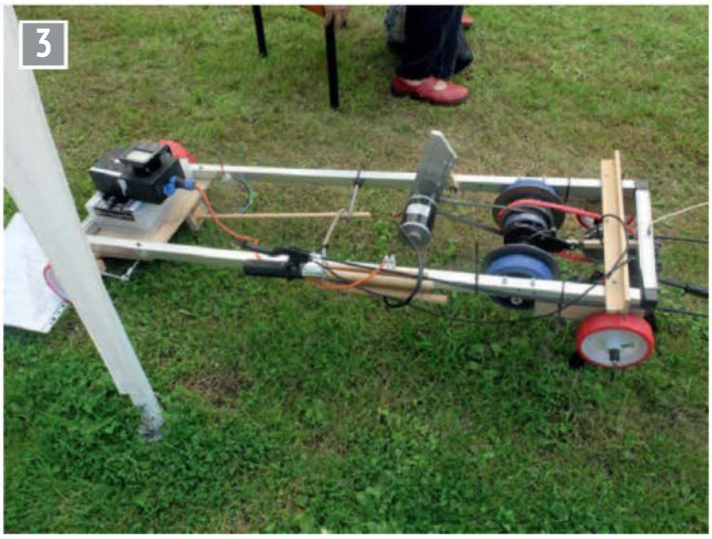
My radio bench - sometimes it looks much more untidy…

2



Solar train.

3



Bolide, early days at a Sheffield Model Engineers Open Weekend, I can't establish the year. Note the tiller connecting to the Ackermann steering.

4

Me riding on Bolide, in 2020.

Achievements

Personal achievements are making a 45 mm gauge solar powered train and operating it at the Sheffield model engineers track. It consisted of an IP Engineering 'Rapier' and four parcel trucks, each carrying a solar cell, fortuitously fitting the trucks almost exactly. Despite a thorough search, I could not find the original photographs, so this is an exact reconstruction, although electrically incomplete (**photo 2**). Also, making from scratch a rather bigger 7¼ inch gauge, electric locomotive-cum-go kart, *Bolide,* role convertible by changing the wheels, and which drove me round the said Society's track (**photos 3** and **4**) and, still incomplete, a five-inch gauge, electric, diesel-outline 0-4-0 locomotive to do the same,

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Deborah, *November 2022, after a winter of cold, rain and indolence.*

Deborah (**photo 5**). In radio, apart from my published written work, I made a multiband short-wave radio transceiver from a kit supplied by an Indian company and built it into a case bought at a rally for £2. I built my own radio telescope and numerous small projects about which I wrote in an almost regular column (about 50 over the past 5 years) for *Practical Wireless.*

Lastly, my attention was drawn to this photo which was posted by a biker but he does not know who took it. Or where it was. So, if you know, Patient Reader, I would I would love to attribute it to the enthusiast who conceived it… (**photo 6**).

When I first went on the Internet I found a free, no qualifications required, clerical ordination as Reverend in the Universal Life Church. So, I remain, respectfully, 'Yours faithfully, Brigadier the Reverend Geoffrey Thomas Baluchistan Theasby, CDM & Bar, (Mrs)'.

ME

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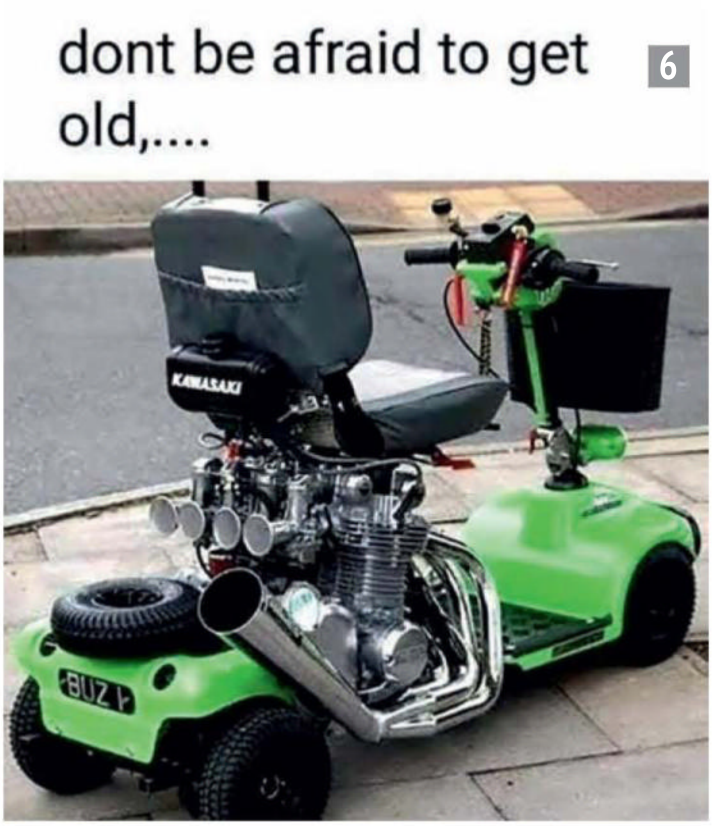

A fast scooter.

Club Diary 18 June – 5 July 2023

June

18 Bradford MES
Public running day, Northcliffe, 13:30. Contact: Russ Coppin, 07815 048999
18 Bristol SMEE
Public running at the Ashton Court Railway BS8 3PX, noon-17:00. Contact : secretary@bristolmodelengineers.co.uk
18 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com
18 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info
18 Taunton Model Engineers
Public running, Vivary Park, 14:00-17:00. See www.tauntonme.org.uk
18 Warrington and District MES
Running day at the club track. See www.wdmes.org.uk/events
22 Sutton MEC
Afternoon run from 12 noon. Contact: Paul Harding, 0208 254 9749
24 Brandon and District SME
Running/family day, Weeting track. See www.brandonanddistrictsme.com
24 Bromsgrove SME
Modern Traction Day – all gauges welcomed, 5, 3½, 2½, G1 and 16mm. See www.bromsgrove.co.uk Contact : Doug Collins, 01527 874666
24 Erewash Valley MES
Narrow gauge gathering at Borrowash track. Raised and ground level. Gauges 2½ to 7¼ and 16mm. See ErewashValleyMES.co.uk or contact M. Bannister 0115 925 8409
24/25 North Wilts MES
Club rally at the Coate Water Railway. Apply to Joe Rekowski (jxrpost@gmx.co.uk or 07921-802889) for your place.
24 Sutton MEC
Fete at Worcester Park. Contact: Paul Harding, 0208 254 9749
25 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com
25 Newton Abbot and District MES
75th anniversary BBQ at club site. See nadmes.org.uk
25 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info
25 Warrington and District MES
Running day at the club track. See www.wdmes.org.uk/events

July

1-2 Guildford MES
Stoke Park Railway Gala, 10:00-17:00. See www.gmes.org.uk
2 Bristol SMEE
Public running at the Ashton Court Railway BS8 3PX, noon-17:00. Contact : secretary@bristolmodelengineers.co.uk
2 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com
2 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info
2 Taunton Model Engineers
Public running, Vivary Park, 14:00-17:00. See www.tauntonme.org.uk
2 Warrington and District MES
Running day at the club track. See www.wdmes.org.uk/events
5 Bradford MES
Steerage trophy competition, Wibsey, 19:30-22:00. Contact: Russ Coppin, 07815 048999
5 Bristol SMEE
Talk: Tower Clocks, Begbrook Social Club BS16 1HY, 19:30. Contact : secretary@bristolmodelengineers.co.uk

Fire Queen Copper Boiler

PART 2

Luker goes old-school and designs a copper boiler

Continued from p.752
M.E.4718 June 2

Silver brazing rods are incredibly expensive and the range of alloys is so vast I could write a book just on the first principles applied in choosing the correct rod for a specific application. Fundamentally, silver brazing alloys with a silver content above 15% will work just fine and generally the model engineering codes will stipulate something similar as a minimum.

Cadmium bearing silver soldering alloys have a much wider melting range. This makes brazing and reheating easier because the lower melting constituents tend to flow more readily into the capillary gap, leaving the higher melting parts behind to form a nice fillet. Cadmium doesn't like to stay in solution at brazing temperatures; this fortuitously results in subsequent heating operations not re-melting existing joints due to the lower cadmium content. It's very possible to silver braze a complete boiler with a wide melting range alloy typical of the cadmium bearing type. Cadmium bearing brazing rods are becoming less common due to health and safety issues, for good reason. Any brazing using cadmium alloys needs to be done in a well-ventilated area; the fumes are particularly poisonous. A health and safety warning that comes from a daredevil motorcycle enthusiast, instead of an armchair engineer, is best heeded!

As a general rule, when you move further away from the eutectic point the melting range increases and so does the size of the fillet (**photo 5**). Eutectic point alloys will have a very narrow melting range, normally much lower and is less likely to form large fillets. With that in mind it's a good idea to choose two or three different alloys for welding the boiler, with the highest melting point brazing alloys used for the smaller sub-assemblies (less copper to heat up and they will be the first heats) and as the boiler assemblies grow the lower melting point alloys are used. The alloys you end up choosing will depend on the local boiler inspector requirements and what is locally available.

I would personally stay away from the zinc bearing brazing alloys (sometimes referred to as 'spelter'), as the melting point is much higher and it's far more difficult to get the alloy to flow inside the capillary gap.

In the end when you have settled on the filler brazing alloy and cleared it with the club boiler inspector, it's always best to buy a small amount and test it on a little piece of scrap to make sure it can be easily melted, the joint is good and your available equipment is up to

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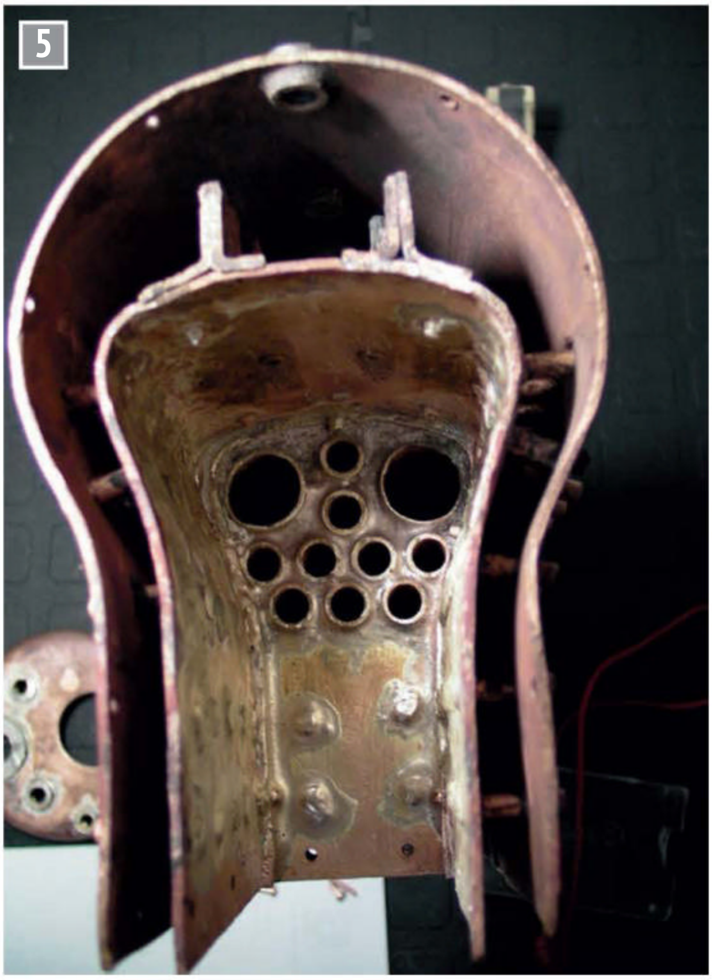

A silver brazing alloy with a wide melting range will give full fillets and is easier to reheat without re-melting.

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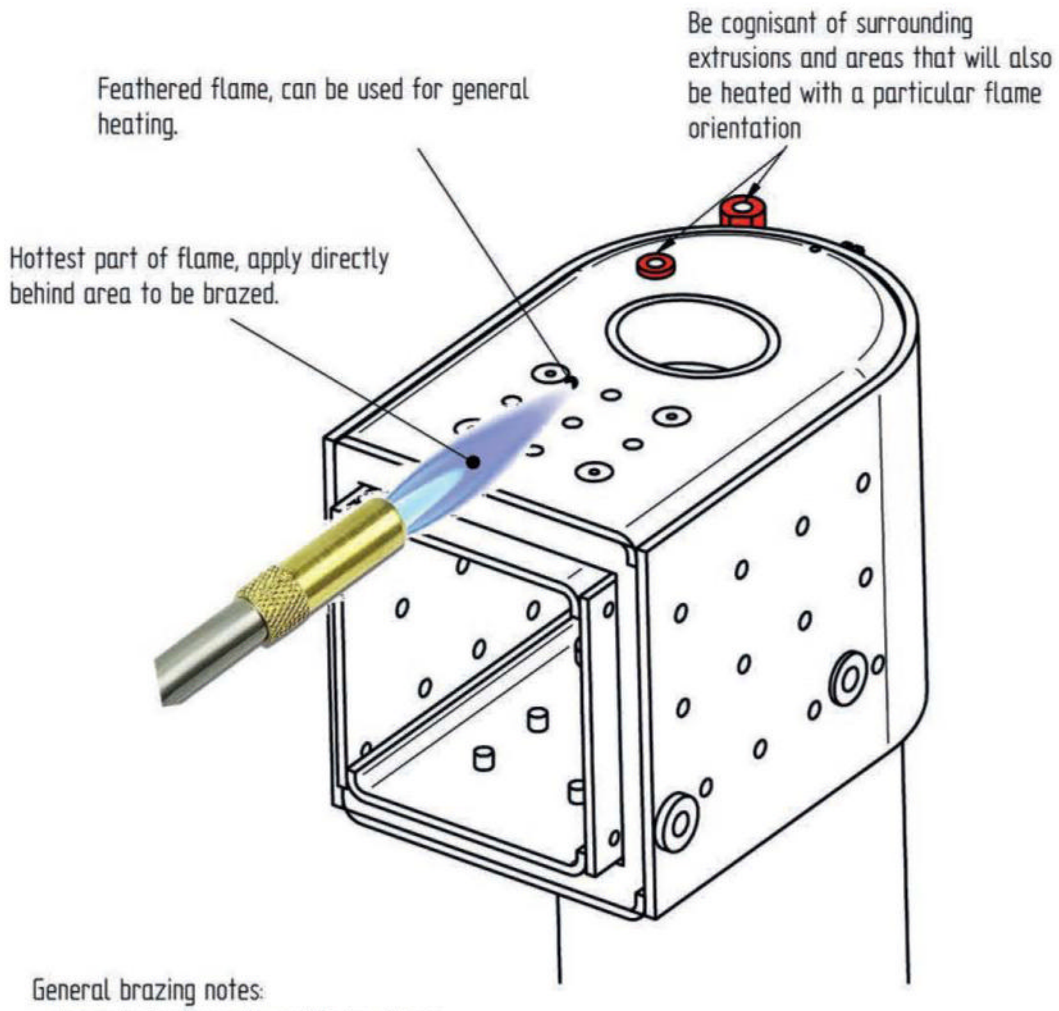
the task. All the copper boilers I have manufactured were done using a cheap brazing torch, fuelled from a household heater propane tank with refractory bricks and insulating blanket to prevent heat loss. You don't need more than that!

The finer minutia (and some general brazing tips) of the assembly plan for *Fire Queen* will be left to a number of sketches (**figs 4**, **5** and **6**). These give a step by step guide of how I would go about silver brazing the boiler for *Fire Queen*, but the general process is identical to the round top boilers I have silver soldered in the past and keeps the assembly open

Fig 4

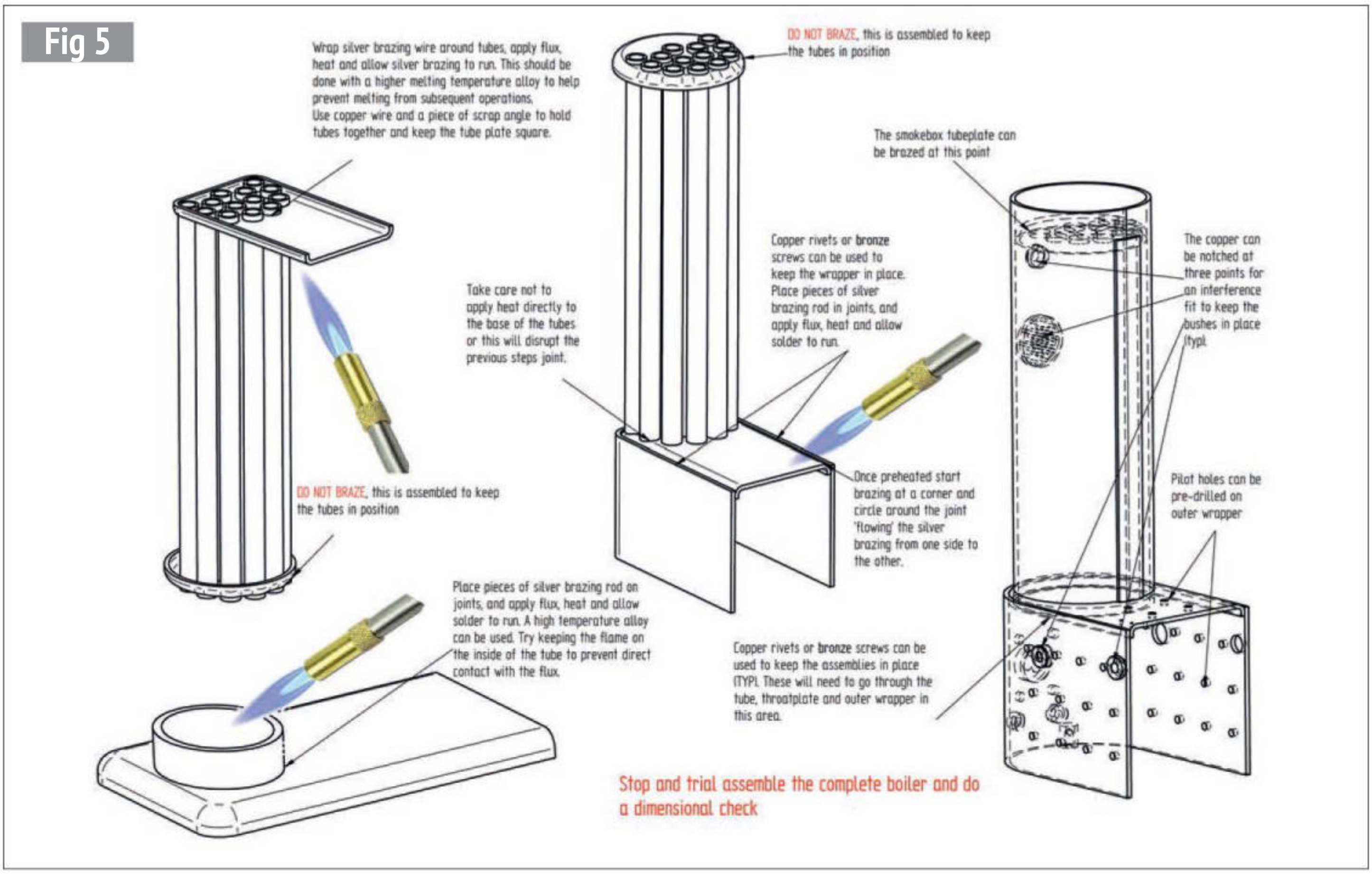

Be cognisant of surrounding extrusions and areas that will also be heated with a particular flame orientation
Feathered flame, can be used for general heating.
Hottest part of flame, apply directly behind area to be brazed.

General brazing notes:
- Areas to be brazed need to be clean.
- Insulate areas that won't be brazed to decrease brazing time.
- All brazed areas need to be fluxed before heating.
- The complete assembly needs to be preheated to a dull red before focusing the flame closer to the area that will be brazed.
- Don't heat the assembly for too long; the flux has a limited working time.
- Try not to put the flame directly on the flux. It's always better to have the flame at the back or side and allow the brazing to run towards the heat, into the joint.
- The orientation shown in the diagrams is recommended for each operation, unless otherwise noted.
- Pickle after each heating operation.
- The joint should have a smooth uniform appearance with no bubbles or inclusions if brazing was successful.
- Plan brazing operations and assembly to avoid unnecessary handling and to minimize the amount of heats.

Brazing in the context of these notes is by means of a Silver copper alloy, with the minimum specifications as stipulated by the regional boiler code. Check the phase diagram for heating ranges to determine the best alloy for each brazing step.

Applying the flame in silver brazing.

Fig 5



Wrap silver brazing wire around tubes, apply flux, heat and allow silver brazing to run. This should be done with a higher melting temperature alloy to help prevent melting from subsequent operations. Use copper wire and a piece of scrap angle to hold tubes together and keep the tube plate square.

DO NOT BRAZE, this is assembled to keep the tubes in position

The smokebox tubeplate can be brazed at this point

Take care not to apply heat directly to the base of the tubes or this will disrupt the previous steps joint.

Copper rivets or **bronze** screws can be used to keep the wrapper in place. Place pieces of silver brazing rod in joints, and apply flux, heat and allow solder to run.

The copper can be notched at three points for an interference fit to keep the bushes in place (typ).

DO NOT BRAZE, this is assembled to keep the tubes in position

Once preheated start brazing at a corner and circle around the joint 'flowing' the silver brazing from one side to the other.

Pilot holes can be pre-drilled on outer wrapper

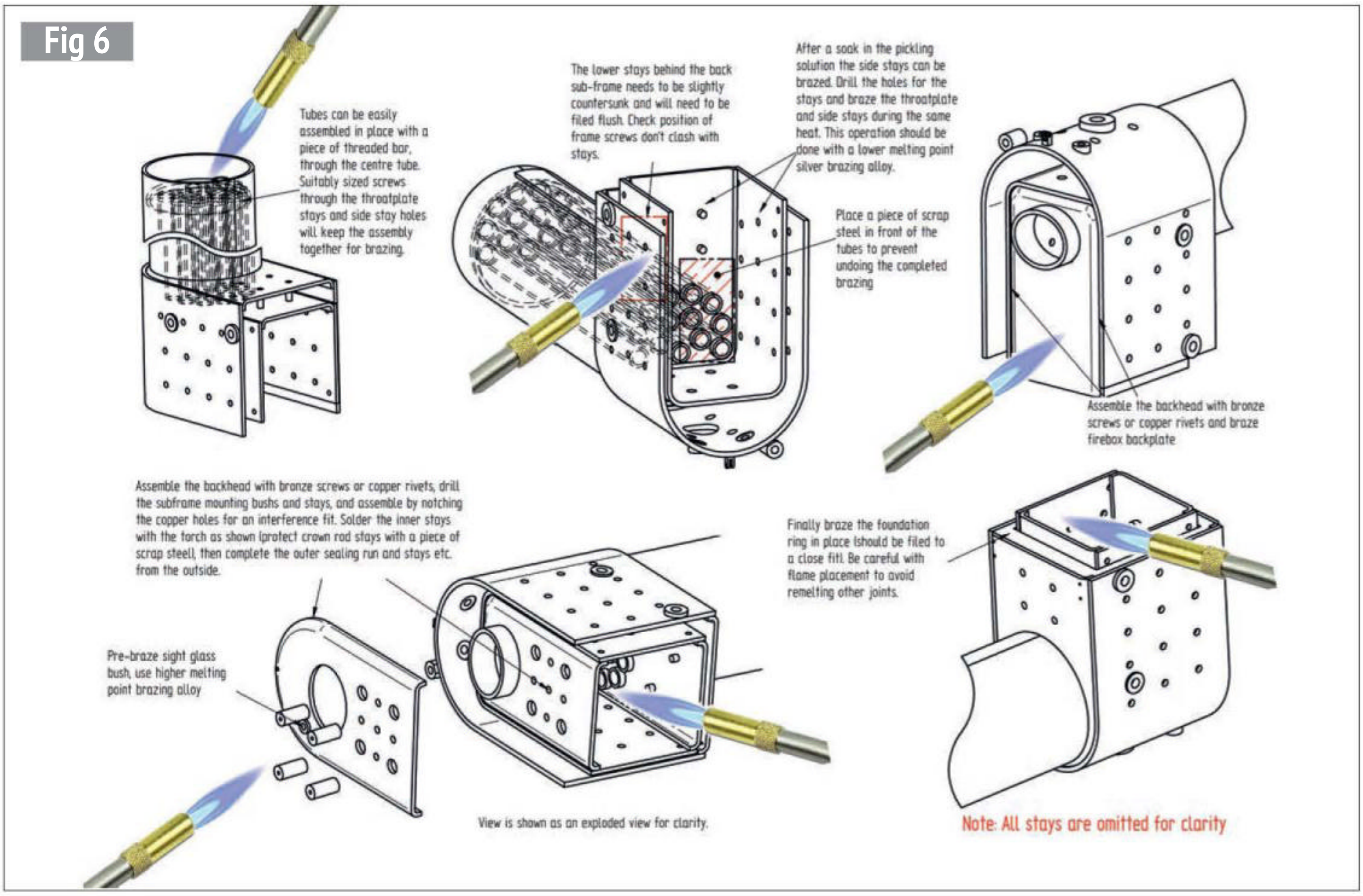
Place pieces of silver brazing rod on joints, and apply flux, heat and allow solder to run. A high temperature alloy can be used. Try keeping the flame on the inside of the tube to prevent direct contact with the flux.

Copper rivets or **bronze** screws can be used to keep the assemblies in place (TYP). These will need to go through the tube, throatplate and outer wrapper in this area.

Stop and trial assemble the complete boiler and do a dimensional check

The steps in brazing a boiler - 1.

Fig 6



Tubes can be easily assembled in place with a piece of threaded bar, through the centre tube. Suitably sized screws through the throatplate stays and side stay holes will keep the assembly together for brazing.

The lower stays behind the back sub-frame needs to be slightly countersunk and will need to be filed flush. Check position of frame screws don't clash with stays.

After a soak in the pickling solution the side stays can be brazed. Drill the holes for the stays and braze the throatplate and side stays during the same heat. This operation should be done with a lower melting point silver brazing alloy.

Place a piece of scrap steel in front of the tubes to prevent undoing the completed brazing

Assemble the backhead with bronze screws or copper rivets and braze firebox backplate

Assemble the backhead with bronze screws or copper rivets, drill the subframe mounting bushs and stays, and assemble by notching the copper holes for an interference fit. Solder the inner stays with the torch as shown (protect crown rod stays with a piece of scrap steel), then complete the outer sealing run and stays etc. from the outside.

Finally braze the foundation ring in place (should be filed to a close fit). Be careful with flame placement to avoid remelting other joints.

Pre-braze sight glass bush, use higher melting point brazing alloy

View is shown as an exploded view for clarity.

Note: All stays are omitted for clarity

The steps in brazing a boiler - 2.

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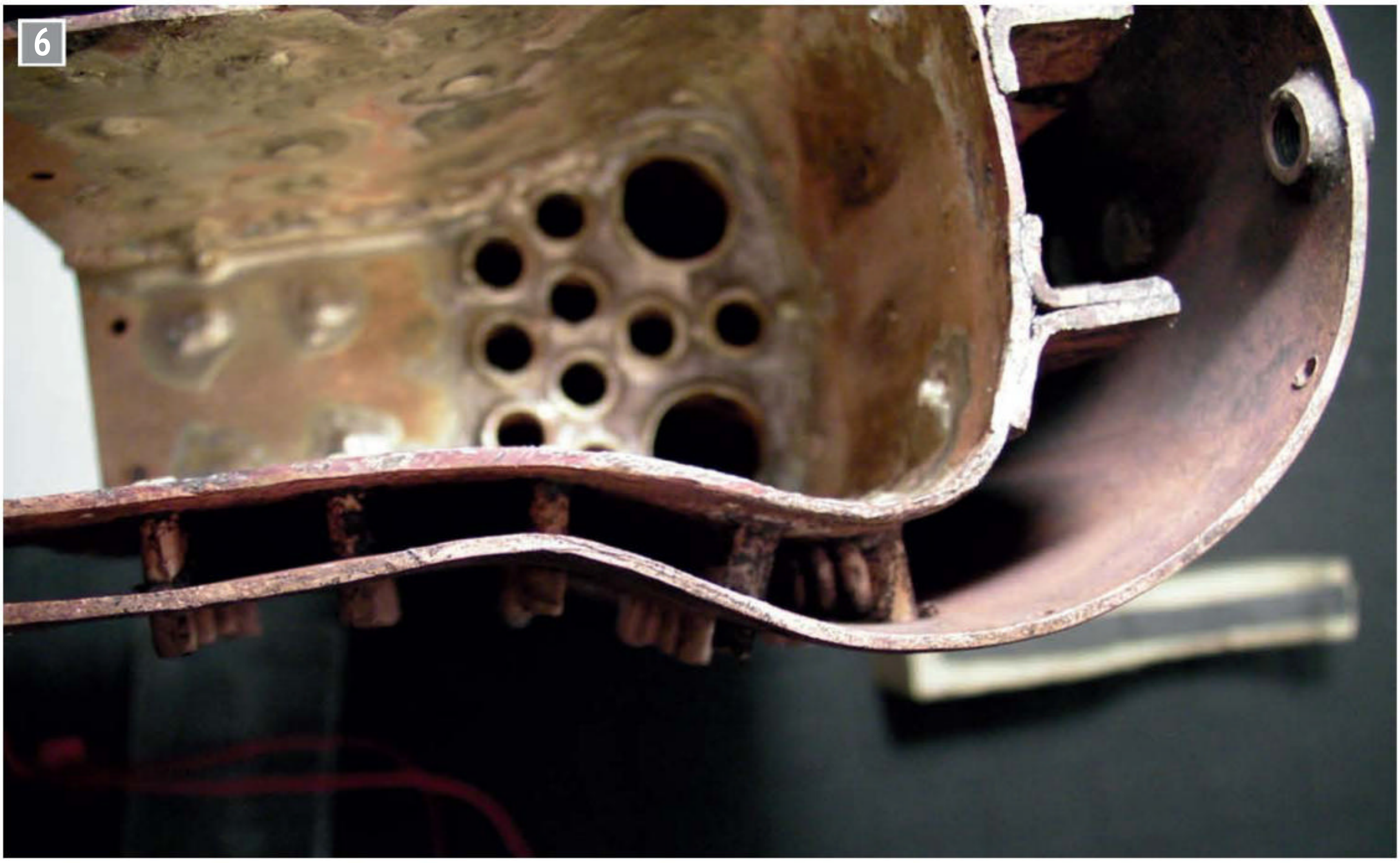
6



Keeping the assembly open as long as possible is advantageous to see if the silver solder has flowed through the plate, especially at the stays.

as long as possible to keep an eye on all the brazed joints (**photo 6**). The opposing school of thought is to close the boiler and check for pinhole leaks before soldering the stays, but it is incredibly difficult to keep the torch flame lit inside the closed firebox and even more so to stop previous joints from letting go. One last tip on brazing would be to keep a lamp or candle at the back of the hearth space to quickly relight the torch if it blows itself out.

The TIG welded copper boiler

The biggest stumbling block with a copper welded boiler is the rather vague welder qualifications and experience sometimes required by the model engineering boiler codes. Copper welding is so uncommon in industry that it is highly unlikely you would find someone that would be able to showcase the required qualification and if they can, it's likely the type of copper welding they do isn't pressure vessel related. Then of course, if you find such a person the chances of them having as fine a grasp of metallurgical fundamentals as a model engineer (that has taken the time to do a little research) is practically nil. The best we can hope for is that the sound design, rigorous home testing, shell pressure test and supplied samples will be enough for a skittish club boiler inspector to accept a TIG welded boiler!

The welding procedure and methods are very similar to the methods previously described (see *Luker*, *Modern Boiler Construction Methods for the Model Engineer*, *Model Engineer*, 2022, 228:4686 and 4688). The biggest mistake most builders make is to try and weld without preheating (typically around 400 degrees C). The model builder might not have access to fancy temperature chalk or infrared thermometers, so a practical test is necessary: if you start welding and a weld pool forms then the temperature is correct. For the most part the boiler needs to be covered with a welding blanket (non-flammable insulation will work) to prevent heat loss, especially if a smaller welder is used. Heat input balance is the name of the game when welding copper. The higher the preheat the less amperage would be required to form a weld pool. For this boiler I would start at a minimum of 100 amps, with the given preheat and see how the welding goes. The idea is for the welding heat input to maintain the inter-pass temperature as the boiler is welded. Practically this just means you shouldn't need to stop and apply torch heat regularly as you weld.

Sometimes the copper filler rod can only be bought in large amounts, but a little trick I've used in the past is to ask for the data sheet of the filler rod and compare it to commercially available single core electrical copper wire. The wire I sourced was identical in terms of metallurgical trace elements (this is where you need to look closely!) and welded perfectly. The likeliest cause of issues would be low melting alloys or sulphur/phosphor or tin which will cause porosity and hot tears, both of which will be visible after welding a test piece.

As with any welding, nothing beats a test sample (**photo 7**). Most welding issues, especially with copper that doesn't have sensitising issues, will show up very quickly. The weld should be clean with no undercutting or hot tears or porosity. The base metal should match the copper filler rod closely, so when bending the test sample no cracks should appear (remember the copper would be soft annealed so it will be very ductile).

There is a tendency in heavy industry to use dissimilar filler rods especially when welding structural copper assemblies. Normally this is restricted to MIG welding. One of the benefits is the ability to weld at a slightly lower preheat. This is not recommended for any copper boiler; it's likely the joints would leak due to sidewall fusion issues.

Some silver brazing will be necessary on a copper TIG

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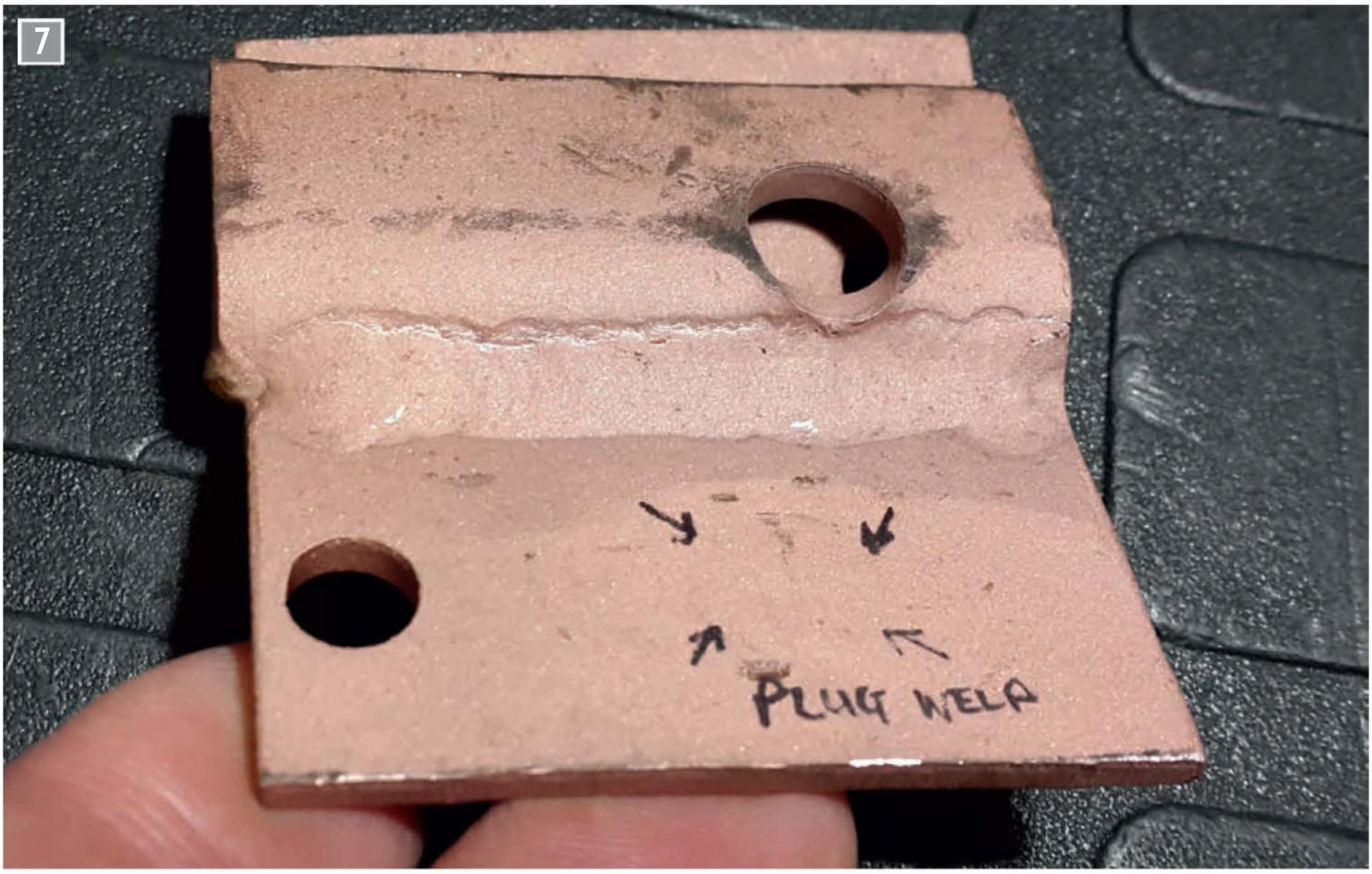
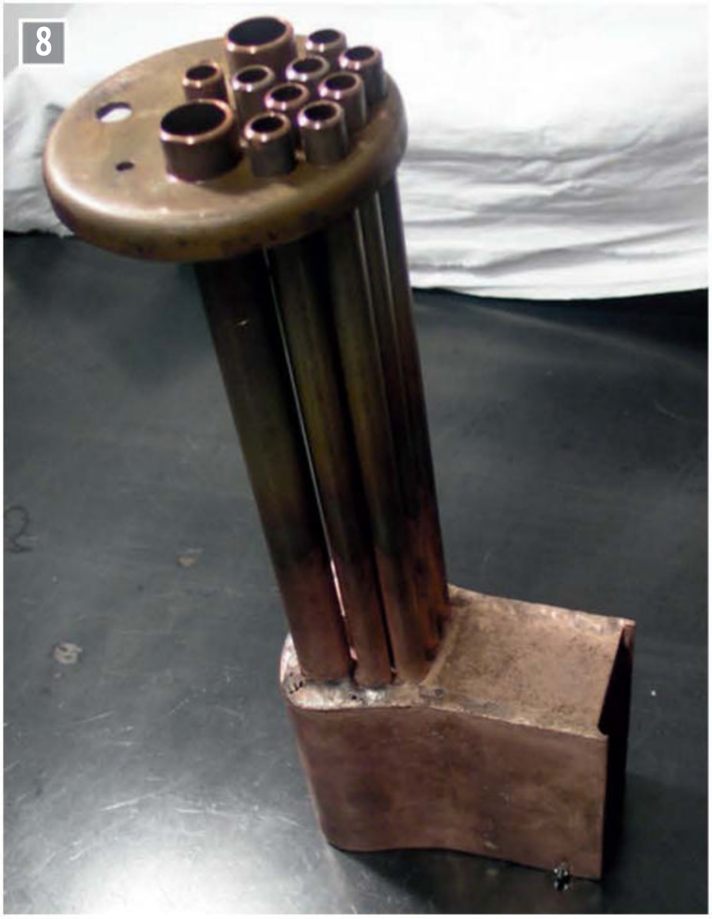


A TIG welded copper test sample (using single core copper electrical wire) bent to check for low melting elements on the grain boundaries which would result in cracks or tears.

8



The beginnings of a copper TIG welded boiler. Most of the main joints are TIG welded with the dissimilar bushes silver brazed.

welded boiler. The bushes are best silver brazed making the boiler a hybrid construction. These can be brazed prior to assembling the boiler, so the heat input will be far less than a fully silver brazed boiler. It is, of course, possible to TIG weld dissimilar metals, but the rods are not readily available and it's unlikely the join will be any stronger than a properly brazed bush.

If a copper TIG welded boiler is the preferred option (**photo 8**) the design and assembly sequence, as shown, can be followed. This differs slightly from the stainless fabrication methoding due to the preheat requirement which would make welding the stays on the inside of a closed firebox uncomfortable.

Boiler testing

Without exception any boiler should be tested. This is the single most important step in any boiler's life and, provided some common sense is maintained when steaming, a positive test is a good sign the boiler will give many hours of uneventful steaming.

My boiler designs can be tested regularly without any cyclic damages, so any builder that needs to humour the club boiler inspector on a regular basis should not worry about low cycle fatigue.

A side note on all the mounting holes

There are a number of mounting points directly to this boiler. For drilling and tapping the holes, paraffin mixed with 10% spindle oil (from your last lathe service) can be used as a tapping fluid. All the mounting holes shown as M2 should be changed to M3 and thread locking compound should be used on the final assembly to avoid the need for excessive assembly torque. Automotive RTV silicone should be applied between the cylinder pad and boiler, on final assembly. I would prefer this to soft solder which is more permanent and makes any future copper repairs difficult.

ME

We Visit the Pickering Experimental Engineering and Model Society

PART 2

John Arrowsmith visits another club in North Yorkshire well-known for the quality of its work.

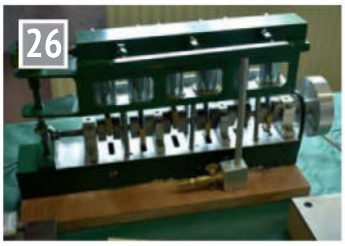
Continued from p.733
M.E.4718 June 2

Having had a very special morning visiting the main workshops etc. of the Pickering Engineering and Experimental Model Society I was then taken to the town centre hall, where the club hold their regular club meetings, to have lunch and to see a veritable feast (sorry about the pun) of superb model engineering. For the last couple of years there have been few major model engineering shows in the UK but here I was lucky enough to be invited to see a special exhibition arranged by members - just for me and the readers of *Model Engineer*. I hope my photos and descriptions provide a flavour of this exhibition and what the endeavours of this Society can produce. The array of models and equipment displayed was quite extraordinary, ranging from small oscillating engines to large, useful pieces of engineering equipment.

25

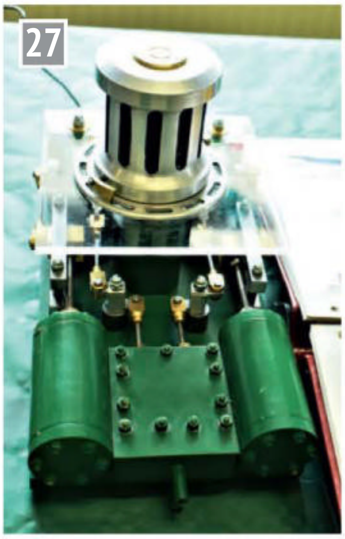
Brian Stephenson adjusting his twin cylinder paddle engine which formed part of his display.

Where do I begin? Brian Stephenson is a prolific builder and he had a range of excellent models on show including a twin cylinder paddle engine (**photo 25**). His 6 cylinder experimental engine will be quite a machine when it is completed (**photo 26**). Alongside this was a

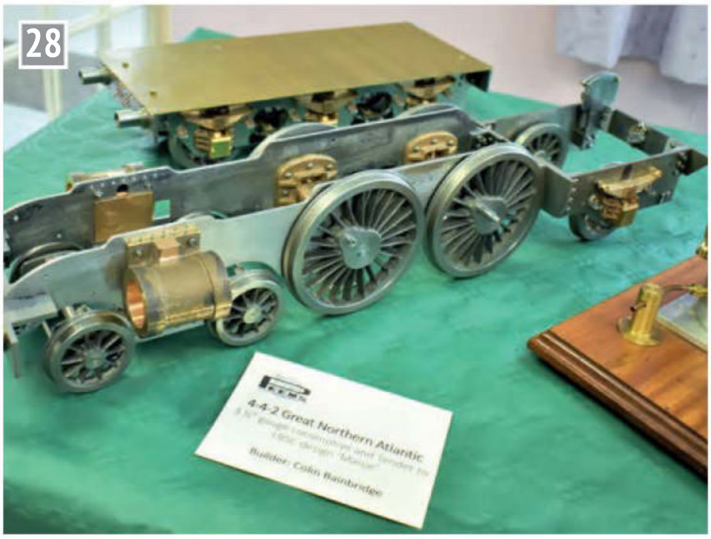


The 6 cylinder experimental steam engine being built by Brian Stephenson.

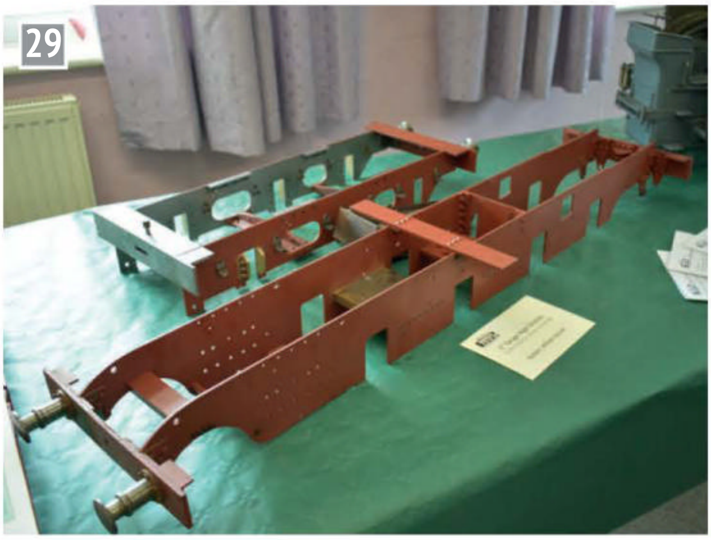
smart looking twin cylinder capstan engine (**photo 27**). Colin Bainbridge is making good progress on a 3½ inch gauge Great Northern Atlantic 4-4-2 to the LBSC Maisie design. The tender chassis looks almost complete with some excellent riveting on the buffer beams (**photo 28**). Another locomotive chassis was on show - a 5 inch gauge design of Martin Evans; *Nigel Gresley* being built by William Burrell. He still has a way to go but he's showing some good workmanship (**photo 29**).



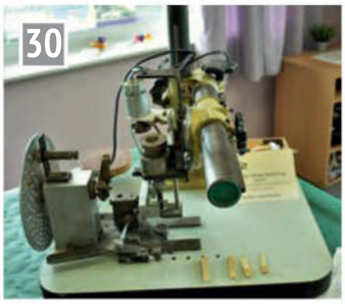
The twin cylinder capstan engine was built by Brian Stephenson.



A 3½ inch gauge Great Northern 4-4-2 locomotive under construction by Colin Bainbridge.



This 5 inch gauge 2-8-0 locomotive and tender is the work of William Burrell.



The wooden wheel machining centre for spokes and fellows built by Peter Bramley.

Moving onto some useful equipment, the wooden wheel machining centre by Peter Bramley is an unusual piece (**photo 30**). It is used for making spokes and fellows for wooden wheels. This was alongside another rare example of a 1½ inch scale Fowler crane engine. This fine piece of work still needs some details fixing as well as painting before it is complete (**photo 31**). Peter's other exhibit was a model of a Chelmsford steam crane circa 1920, obviously with lots of work still to complete (**photo 32**). An interesting and very useful addition to a standard rotary table was the addition of an Arduino/ stepper motor which enables precise work like gear cutting to take place. Built by Ted Fletcher it was another well-made item (**photo 33**). Ted also had a display of workshop tools and equipment

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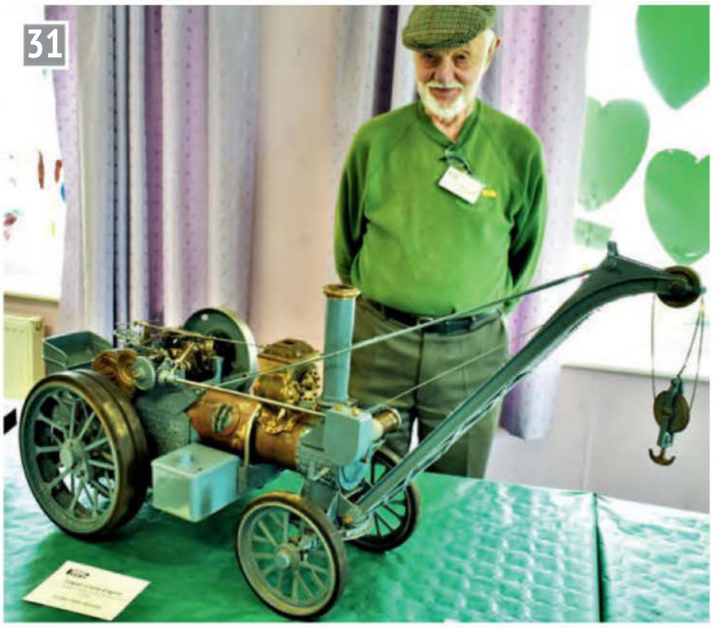
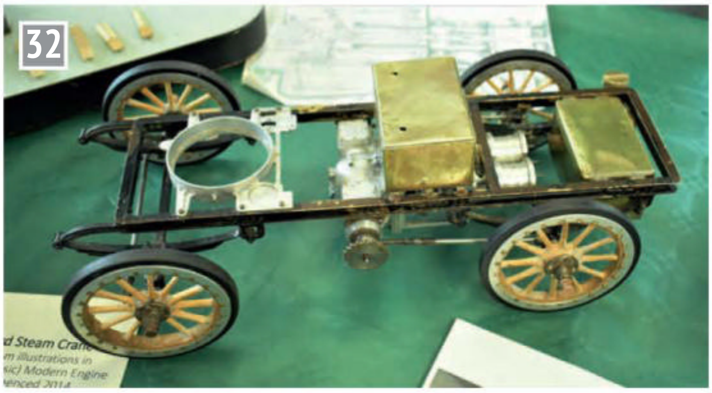
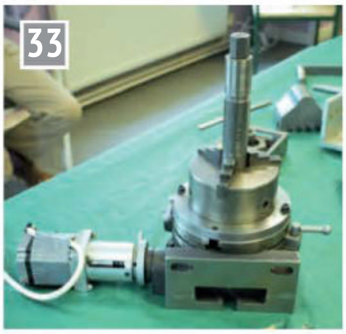


Peter Bramley with his not quite finished Fowler crane engine.

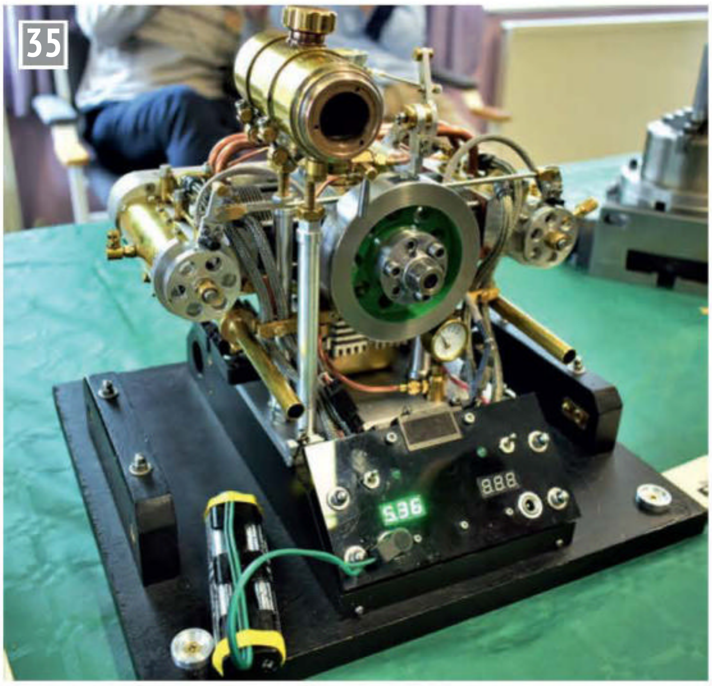


A 1½ inch scale model of Chelmsford crane circa 1920 being built by Peter Bramley.

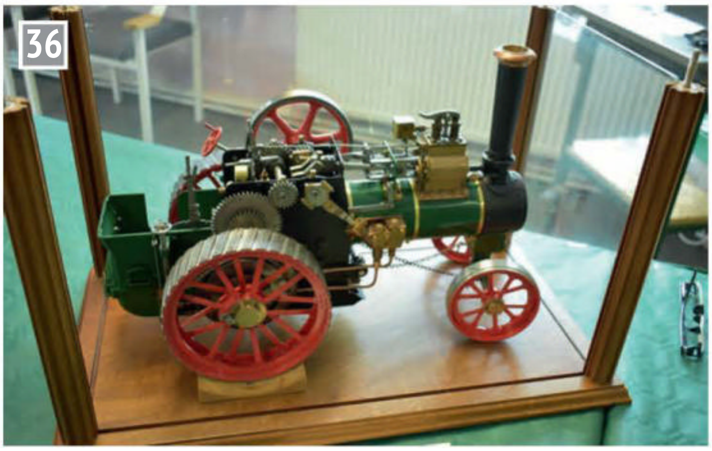


A Rotary table fitted with an Arduino/ stepper motor has been built by Ted Fletcher.

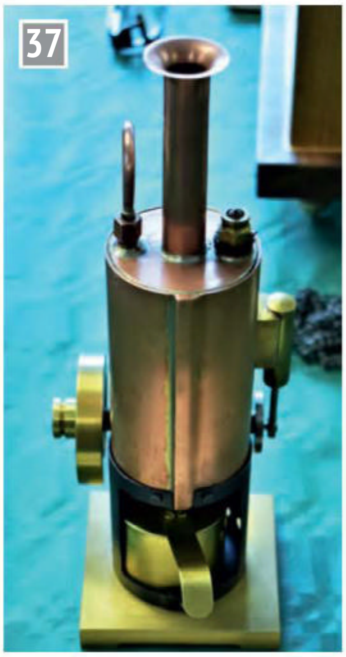
This selection of useful fixtures and fittings is by Ted Fletcher.



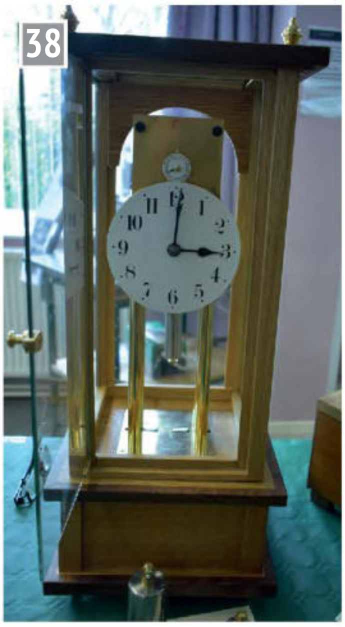
This Flat 4 cylinder 28cc overhead cam I/C engine has been designed and built by Brian Rees.



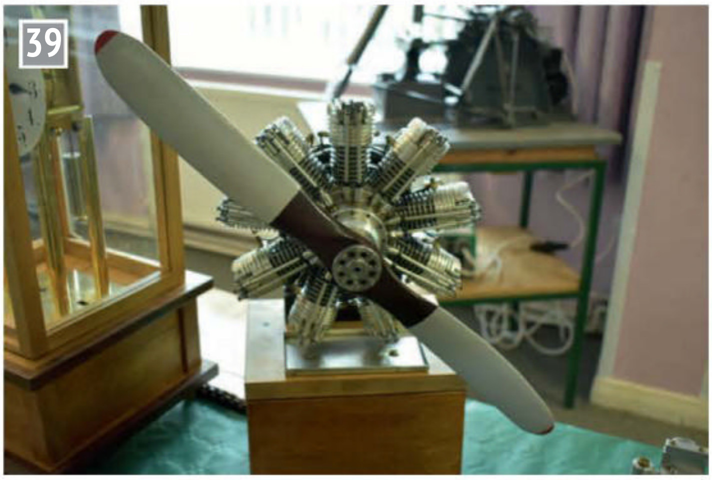
A very nice Minnie traction engine built by David and Adrian Hick.



This small vertical boilered stationary engine was built by David Hick.



A table clock designed by a PEEMS member, Richard Gretton and which was built by David Hick.



This 9 cylinder radial engine was built by John Heeley.

which could be used to provide additional features on other machine tools (**photo 34**).

We met Brian Rees at the club's workshop area where he displayed his 2 cylinder V-Twin engine. In this display Brian brought along his impressive 28cc flat 4 cylinder overhead cam I/C engine for everyone's inspection. Yet again first class workmanship had produced a fine model which had also been designed by Brian (**photo 35**). Minnie traction engines are always popular models and here was another good example built by David and Adrian Hick (**photo 36**). A less complicated model from David Hick was a nice little oscillating engine and boiler which proved to be a useful exercise in a number of disciplines (**photo 37**). David was also responsible for building a good looking table clock which has been designed by a PEEMS member, Richard Gretton and then built by David (**photo 38**). The 9 cylinder radial engine adjacent to the clock is one of many engines on show built by John Heeley (**photo 39**). The selection of assorted engines shown in **photo 40** are all built by John, as is the turbine powered steam boat (**photo 41**). **Photograph 42** shows the man himself with one of his creations, a single cylinder I/C engine.

An interesting model was the 1/3 scale model of a B type Blacker power hammer which was the work of Chris Bramley. He had managed to get a set of works drawings for the full size version and built this excellent model (**photo 43**).

Now for something completely different. Ron Baier was displaying a selection of his solar system models and I have chosen two of his creations to illustrate the complexity of these models (**photos 44** and

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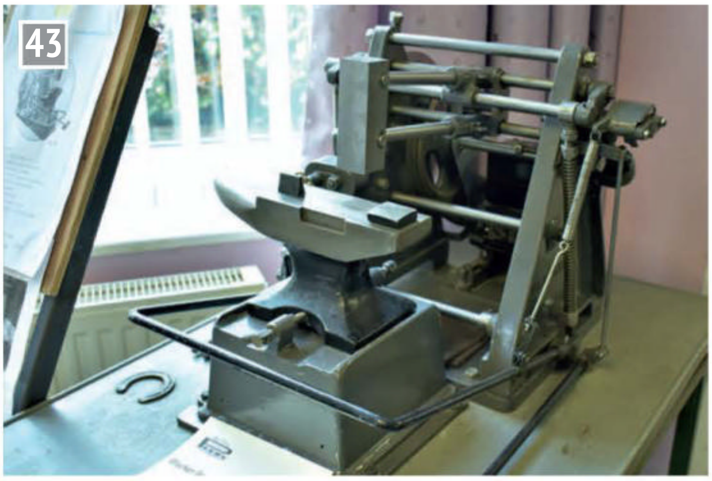
A selection of engines and turbines built by John Heeley.

41

This steam turbine powered boat was built by John Heeley.

42

John Heeley with one of his I/C engines.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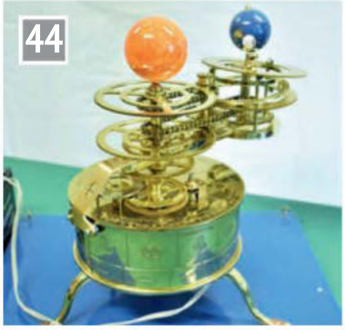
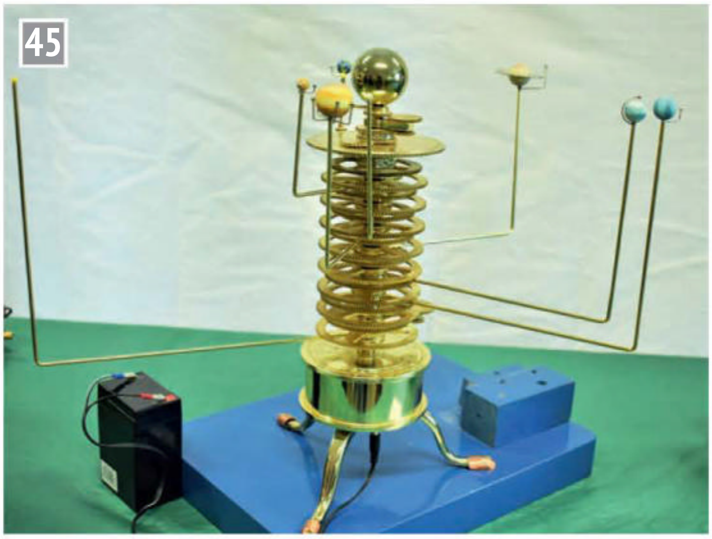
A 1/3rd scale model of a Blacker power hammer, the work of Chris Bramley.


44

One of a group of solar systems built by Ron Baier.

45). They really are works of art in their own right.

Ron Baier is not only a maker of fine mechanisms but he also builds boats and his example of a steam powered launch was one to be proud of (**photo 46**). Alongside this Ron had an example of his boiler and engine making skills with a good horizontal boiler and twin cylindered oscillating engine (**photo 47**). He also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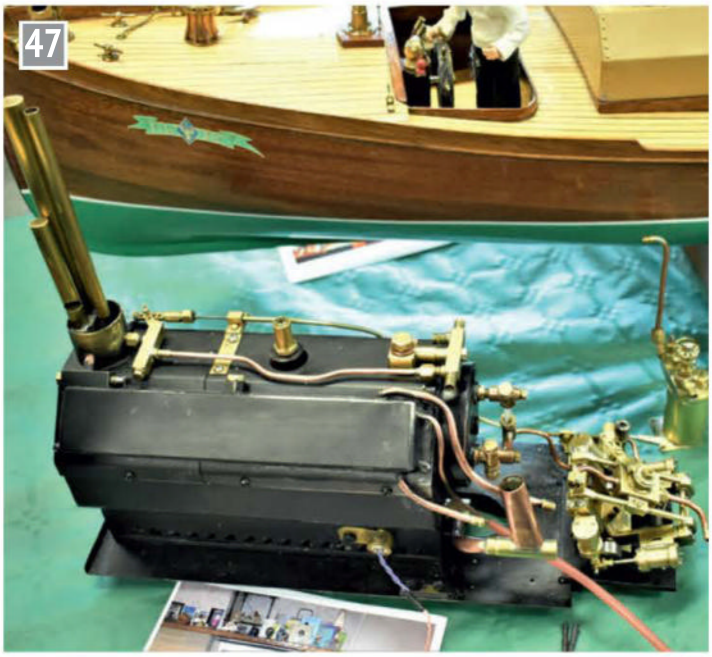
Another Ron Baier built solar system.

46

Ron Baier with his steam powered launch, Miss Minnie Madam.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This twin cylindered steam plant is the work of Ron Baier.

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48

Another Ron Baier model was this 4 cylindered oscillating engine.

49

An ALYN Foundry ALE 1¼ inch bore 'hit and miss' engine renovated by Tony Leeming.

had on show another small oscillating engine but this one had four cylinders (**photo 48**). An ALYN Foundry ALE 1¼ inch bore 'hit and miss' engine was on display and this engine had been renovated by Ted Leeming (**photo 49**). Tony also had on show his 5 inch gauge chassis for a Western region Speedy (**photo 50**) and along with the boiler components (**photos 51** and **52**) it looks to be coming together very well; it will be a fine locomotive when completed. Iain Hale was displaying a continuous torque and variable speed mill/drill table (**photo 53**). It looks an ingenious piece of kit but I am not sure exactly how it works. Perhaps Iain could explain to readers of M.E. the thinking behind this idea in a future article? Another Tony Leeming model was an example of a Stuart Turner D10 twin cylinder engine (**photo 54**). Following the series of articles in *Model Engineer* issues 4576-4615 David Proctor had built a good example of the Martin Gearing designed boiler feed pump (**photo 55**). What was described as Rory's Rocket was a freelance double acting oscillating engine, again built by David Proctor (**photo 56**). An elegant LDCR Europa class tender caught my attention because of the superb workmanship. The 5 inch gauge model is under construction by Paul Gammon and it looked an absolute

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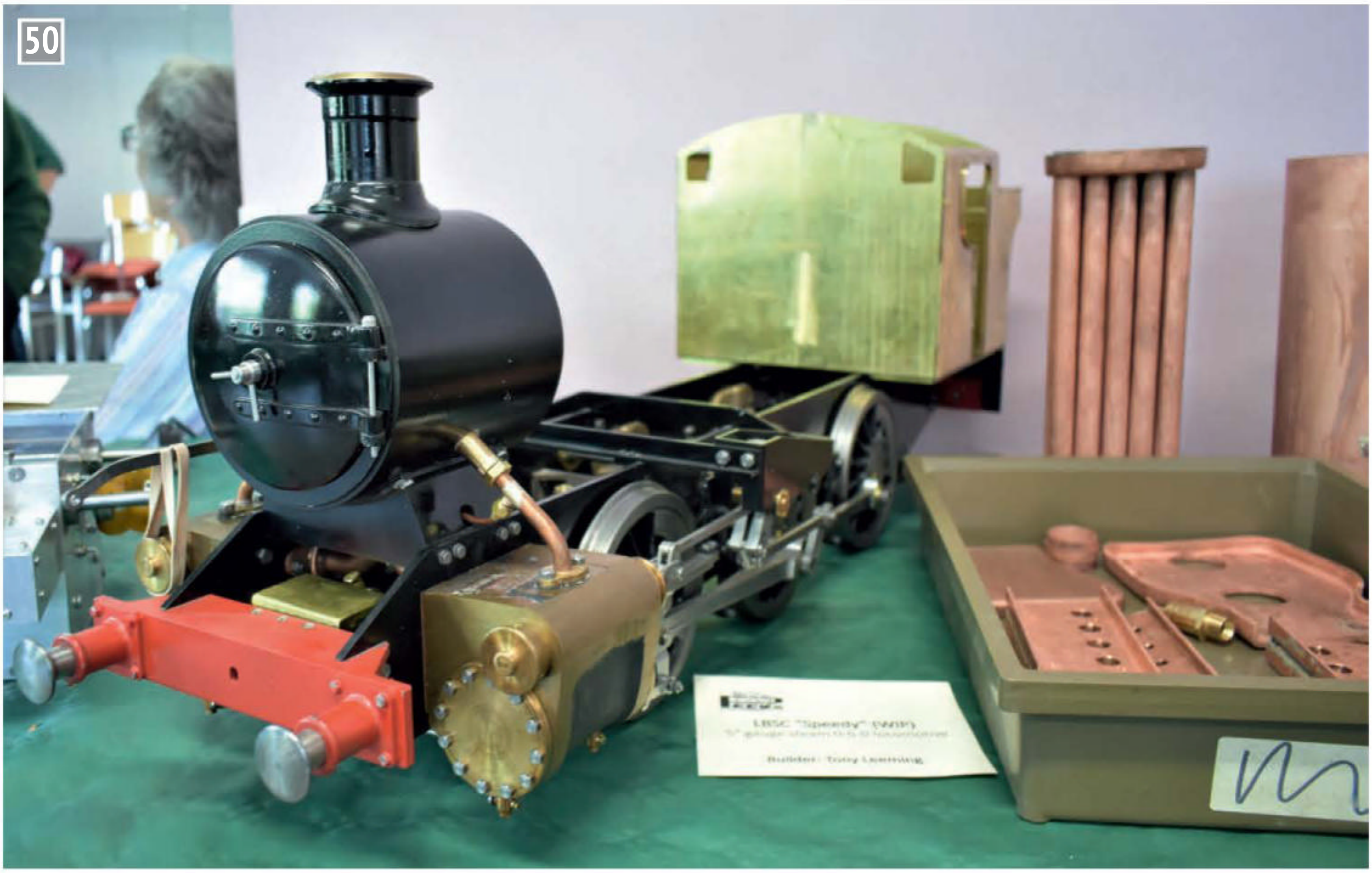
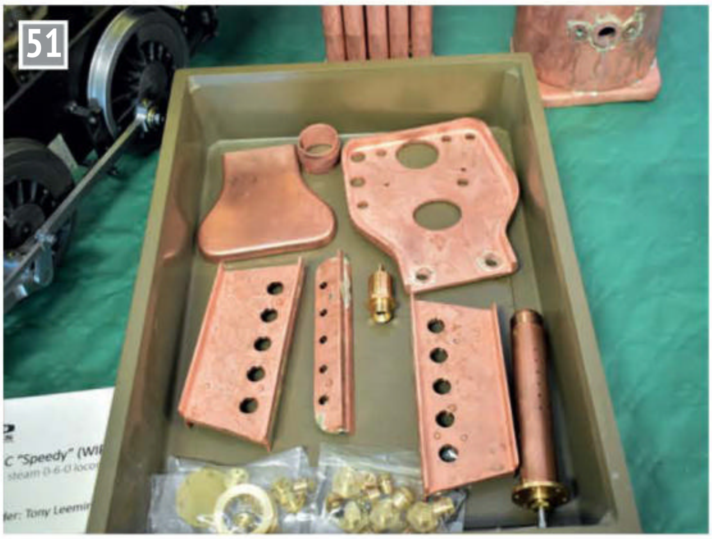


Tony Leeming is building this 5 inch gauge Speedy.

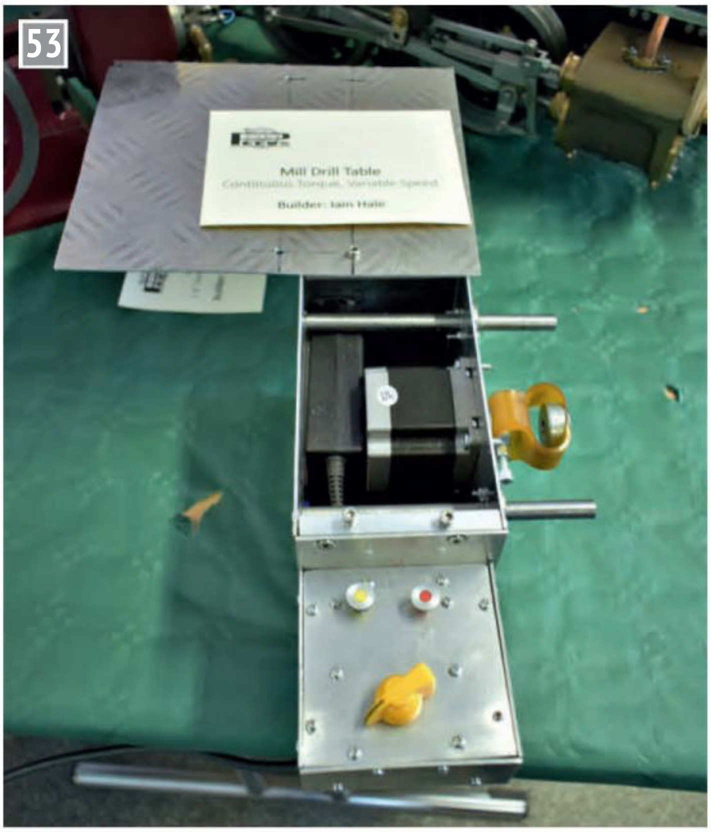
51



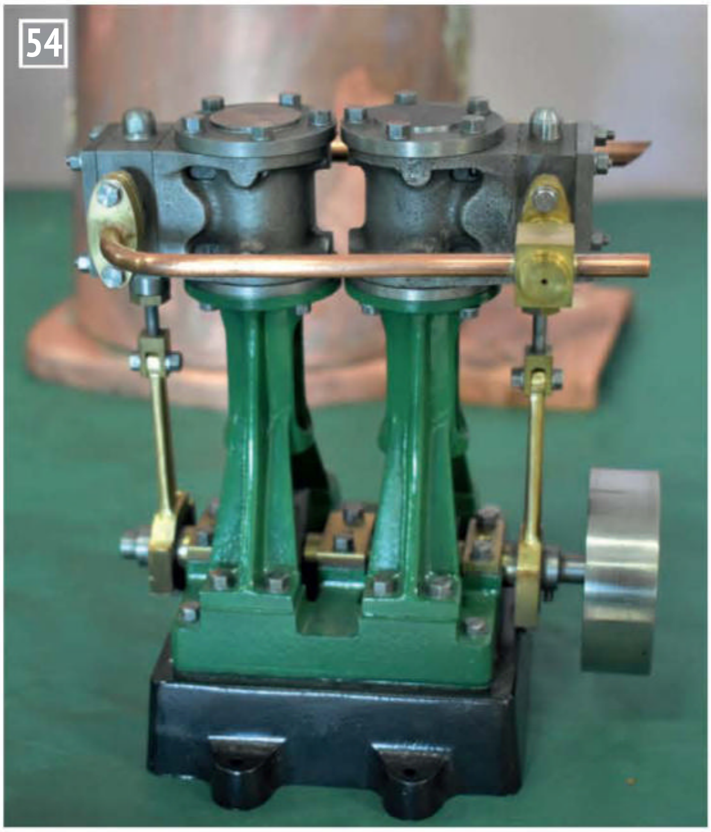
Boiler plates for Speedy.

52

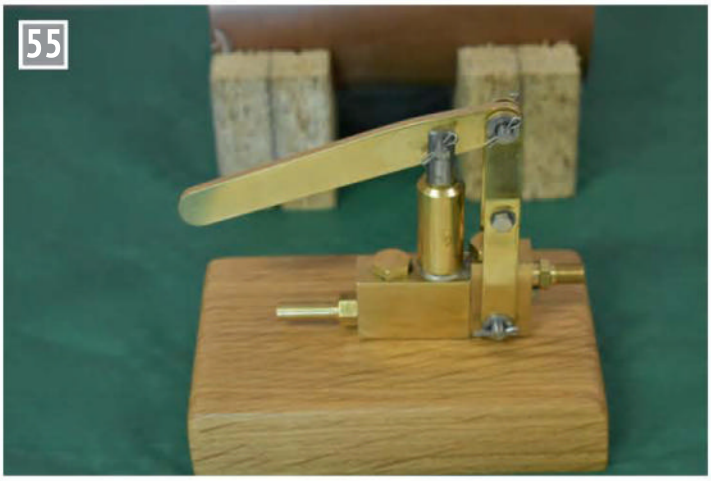
A well-made boiler barrel for Speedy.



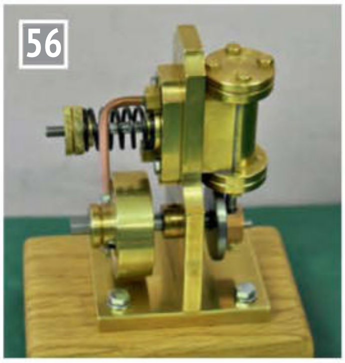
An unusual adjustable mill/drill table built by Iain Hale.



This twin cylinder Stuart Turner D10 engine was built by Tony Leeming.



A nice little boiler feed pump to the Martin Gearing design was built by David Proctor.

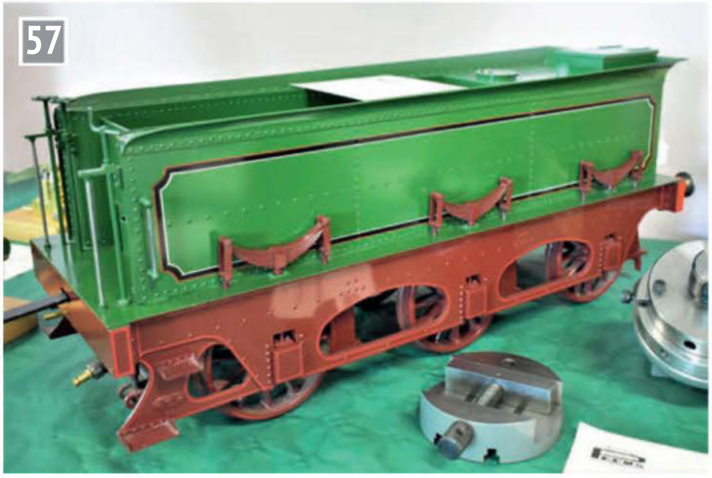


Rory's Rocket, a double acting freelance oscillating engine built by David Proctor.

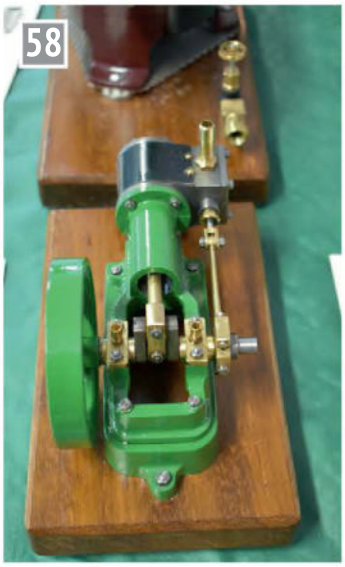
picture in the display (**photo 57**). The final item in this exhibition was again by Paul Gammon in the form of a Stuart 10 horizontal engine (**photo 58**), a simple machine but very well made.

Well that just about sums up an amazing day, with a wonderful morning of working displays followed in the afternoon by a tremendous private exhibition. The members of PEEMS really did put on a show for me and the effort to create such a display of work was incredible. From start to finish the hospitality and welcome extended to my wife and me was really exceptional and was very much appreciated. My sincere thanks to all the members I met; words cannot adequately express my gratitude, you were all superb. Thank you.

ME



Superb workmanship on this 5 inch gauge LDCR Europa class tender under construction by Paul Gammon.



A Stuart 10 horizontal engine by Paul Gammon.

CLUB NEWS

Geoff Theasby reports on the latest news from the clubs.

We editors often have to cope with (and find) papers on which are salient details for the matter in hand. The dull people of this world label paper trays and desk tidies as In/Out/Pending. Others, with their thoughts elsewhere, have created some more imaginative versions:

Cricketer, - In/Out/LBW (or 'Let the Beggars Wait')

Radio Amateur - Receive/Transmit/StandBy

Writer of the Hokey Cokey…?

Rowing coach - In/Out, In/Out, In/Out...

Psephologist - In/Out

Thoracic surgeon with stethoscope, breathe in….. and hope he doesn't forget,

Publican, Inn…

Club News editor - in this issue:

Pickering Experimental Engineering & Model Society *Newsletter* begins with a highly implausible tale from chairman Jonathan, of how US Ford automatic gearboxes are marked for the different performance offered. However, I did see a US car in the Isle of Man Car Museum which had the gears selected by push buttons on the dashboard, so Jonathan might be right! The Society newsletter, PEEMS reports that Bradford Model Engineering Society is holding a radio-controlled locomotive speed trial and have invited PEEMS. The proposed date clashes with their own meeting when Graham Sykes is to present a talk on his steam motorbike. Bradford still want the Pickering Club to enter, so discussions are continuing. At a recent meeting, Tony Simons spoke on the Derwent Valley Railway and the moves to resurrect it. This was expanded into a long (16pp) article on the railway, taking up most of the publication.

W. www.bisarchtest.wordpress.com

1

Manx Northern track still in situ.

More from the *Orchid Line*, the miniature railway at the IoM's Curraghs Wildlife Park, run by the **Manx Steam & Model Engineering Club.** This is possibly the only remaining Manx Northern Railway artefact remaining in situ (**photo 1**) and - Dig This - miniature Volvo JCBs just for the kids at the Orchid Line/Wildlife Park. Great fun (**photo 2**)! Chocolate digestive biscuits – I learned, from meeting the members of the Miniature Railway, a new way to eat them. Hold them chocolate face to chocolate face, that way you don't get messy fingers and you get twice the taste and experience… Search for **www.curraghswildlifepark.im**

(Ed's note: the wildlife park has a very strict 'No dogs' policy!) This slate water tank is at the Peel Maritime Museum, which was closed on the day we called and the odd signal and bit of track is one of the few outward signs of the museum's presence (**photo 3**). One thing we both noticed was the absolute quiet, even in Douglas. No 'city hum', traffic noise, dogs barking, children shouting, even the waves lapping on the shore outside our hotel seemed muted. It was oh, so peaceful. Move over, Simon and Garfunkel! The

2

Volvo diggers at The Curraghs.

Peel transport museum.

frequent 'clip-clopping' of the one horse power tram along the promenade (motive power, William, a 13-year-old 16 hh Clydesdale) was not intrusive. The end of the line (**photo 4**).

In the Manannan Centre, Peel, which is built on the site of Peel railway station, is a picture of IoM ferry, *King Orry III*, leading the German fleet into Scapa Flow at the conclusion of WWI. The story of how this fleet was subsequently scuttled and then refloated and cut up for scrap, is fascinating and sad. What is not often mentioned in discussions on this subject is that the said scrap went to TW Ward in Sheffield and recycled. (https://commons.wikimedia.org/wiki/File:King_Orry_leads_the_German_Fleet_to_Scapa_Flow..JPG)

Another book review: *A Manual of Locomotive Engineering* by Frank Pettigrew of the Furness Railway, is a facsimile reprint of his 1899 edition, thus an almost exact contemporary of this magazine. It is profusely illustrated and contains a wealth of details about making steam locomotives, how they work, repairs and renewals and with separate sections on cylinders, boilers, valve gears, tender, frames, couplings etc. and American and Continental locomotives. I found it quite by accident and I see that it is still available via Amazon, but I did NOT pay the very high price asked for it today.

Only three locomotive engineers have written books about their profession, Bowen-Cooke, Hughes and the above.

Steam Lines, May-June from **Northern Districts Model Engineering Society (Perth)** reports that despite travelling in opposite directions, i.e. from the North and the South and departing on different days, both Phil Gibbons and Kelvin Davis arrived at the venue within 5 minutes of each other. Star of the show was Jack Soames' steam truck, built in only 2½ years. On Saturday a rear wheel seized and it could not be driven back to the compound, so Jack slept out with it overnight and it was repaired the following day after some concentrated effort. 77 locomotives were present with room for more if required. The February and March running days saw warm, dry weather and plenty of locomotives, near perfect for such an event. However some carriages were not available, which did nothing to reduce the queues. The April run also saw no locomotive failures, that's four in a row! Graham Smith writes on his first locomotive project, Don Young's Marie Estelle design, some parts of which do not conform to modern standards, being 40 years old. One problem, says Graham, is that the tender as drawn is 'ridiculously short'. Bill Wall describes some of the modifications he made to his Hafco AL350B and other machine tools in the workshop.
W. www.ndmes.org.au

Horse tram, with William.

Chesterfield & District Model Engineering Society sends a Stationary Engine Special masquerading as *The Stephenson Link* No. 2 of 2023. Of course, the usual niceties are observed, as editor, John Walker says, he is always pleased when the members exhibit an interest in what their fellow members are up to. A recent meeting centred on stationary engines inspired this issue. Years ago, Peter Hawkins wrote about the first such engine built by William Oliver, later Markhams and John republished his article, together with a photo of the model Peter made at the time. Much work has gone into the fencing at Hady Hill, even in the freezing cold. Well done the fencing gang! The 32/45mm gauge track was covered in snow in early March, so Phil and Alan Leyland made a snowplough for their new engine, a 2-6-2 German tank engine. True to real life, it had adhesion problems too! The January meeting with a stationary engine theme was very well attended and produced a wide range of models: hot air, oscillating, inverted vertical, a Stuart No. 1, a No. 9, an S50 and an Edgar Westbury semi-portable undertype. Dan Newton brought five models including a Stuart No. 8 and a PM Research No. 3A. John brought his Stuart Major, not yet painted. Although the flywheel is 14 inches in diameter, he maintains it is a small engine in that some of the fasteners were 10BA. He also continued with his multi-part article on his beam engine. One person claimed that John's locknuts were wrongly fitted and a letter in the last issue on this subject caused a ruckus in one family. David Fletcher brought a number of engines, including an aero engine. Is that a stationary type? Adrian Lloyd, breaking the mould, continues on his articles ostensibly about a Series 2 Land Rover. He found (read: 'could not miss') a very large concrete bunker in his garden, semi-sunken to a depth of 10 feet below ground level. Supposedly an air raid shelter, but far too large for a domestic version and too small for a community version. Eventually, after the 'labours of Hercules', a workshop/garage replaced it and he could fulfil his long felt want (?) and build a kit car, a Hustler 6, made with mini subframes and engine and using flat plywood panels; a sort of Moke. Finally, how to build your own coke-fired blast furnace. **www.aronline.co.uk/cars/towns/hustler/**
W. www.cdmes.co.uk

Debs and I went to the miniature traction engine rally at the **Nottingham Transport Heritage Centre,** at which Nottingham SMEE (see below) is co-located. We attended incognito, so this was not a State Visit, just two interested observers at a miniature TE rally. We did not engage anyone in conversation, we

5

Rallies are sooooo tiring ...

just wandered casually about, bought a couple of used books in the comprehensively stocked bookshop and took in the ambience. (Ambience chasers?) The miniature railway of the NSMEE was not running when we arrived about 11am, but we enjoyed the sight of many traction engines in steam, fascinating children and adults alike (**photo 5**). The miniature railway began taking passengers by about noon. A black NCB tank locomotive was hauling trains full of passengers as we left. Points are awarded to the cafe for the food quality and taste but demerits for the slow service, albeit conducted in a friendly manner. The site was very tidy and clean with white fencing and clearly delineated areas. As we were about to leave, a full scale TE arrived, a Foster single cylinder agricultural of 1927, *Fiery Elias* (**photo 6).** As we were in the area, we travelled about 5 minutes to the Frame Knitting Museum in Ruddingtom. Not knowing much about frame knitting, I was intrigued and found it most instructive, including the manufacture of the needles, which were very small, yet with a hinged and sprung lever to catch the yarn. The knitting frames are about the same size as a hand weaving loom, a similar type of cottage industry in West Yorkshire. An exact sequence of movements had to be made when knitting and this needs to be kept up for hours on end, with pay deductions for mistakes. The situation was therefore ripe for mechanisation.

Kingpin autumn edition from **Nottingham Society of Model & Experimental Engineers,** combined the autumn and winter issues due to lack of copy. The fireworks event proved very popular, with no complaints even though trains stopped running whilst the display was on. A rather good night photograph bears repetition, when I can find the space. Steve and Matt Andrews produced a 3D print of the lever frame for a signal box acquired by John Foxton's private 5 inch gauge railway. John Ollerenshaw visited the Foxfield Steam Railway Club, taking several photographs.

W. www.foxfieldrailway.co.uk

6

Foster general purpose engine, Fiery Elias.

The spring edition reports on the 7¼ inch gauge line extension. Once the digging out had been completed, in April 2018, swarms of members descended upon it such that if you missed a week, you were astonished at the advances made. The first train ran in March 2019, then came the lockdown, which delayed activities for a year. Sophie Harris built a 'Minimal Gauge' Ruston. Defined as, not a scale model, but the real thing built on a small gauge and scale to do real work. Acquiring a Lister LR1 engine for the prototype, it was found to be underpowered for the work intended. A Lister SR1 was found, which was only marginally bigger, at least until it was trial-fitted... In use, the locomotive was found to oscillate in resonance with the suspension, making the driver feel ill. Clearly, a rethink was required. Another engine was disinterred from the workshop cobwebs, 6 HP, electric start and a throttle. This one was far too noisy. He locomotive now runs with a 20 HP V-twin. This runs well, for the moment. Tom Ingall brings an update on the Reunification project. Keep yourself informed via YouTube – GCROfficial - and click on 'subscribe' and the 'Notify' bell. Errol Marcer writes in 'My introduction to computers' how he got a fair organ sound by using a MIDI keyboard and Linux Mint, despite knowing almost nothing about computers.

W. www.nsmee.org.uk

And finally, I slept on some old magazines and now I have back issues...

ME

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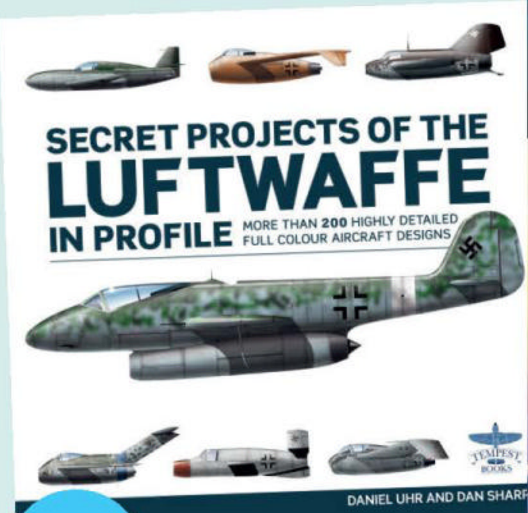
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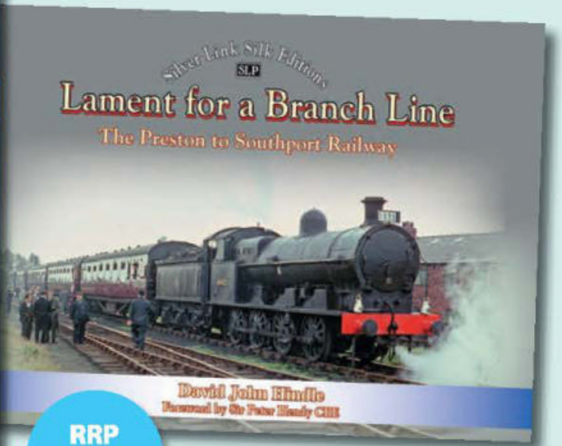
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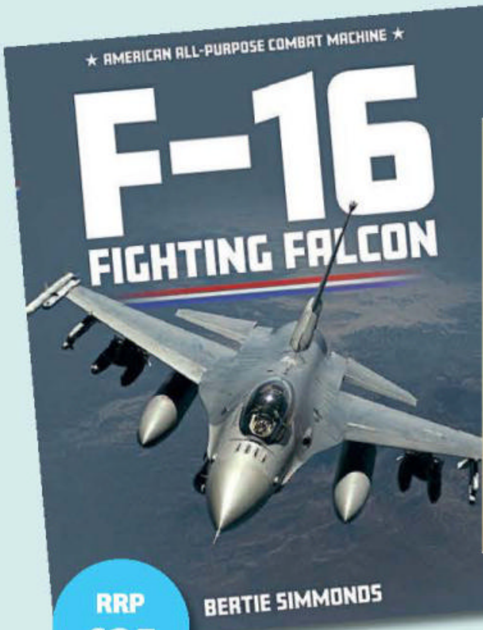
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